WORK PLAN

FOR

- WATERSHED PROTECTION
- FLOOD PREVENTION

COOPER CREEK WATERSHED

LAWRENCE COUNTY, ARKANSAS

September 1964

4-19836 3-65
USDA-SCS-FORT WORTH, TEX. 1965

WATERSHED WORK PLAN AGREEMENT

between the

Lawrence County Soil and Water Conservation District
Local Organization

Cooper Creek Watershed Improvement District
Local Organization

_____
Local Organization

_____

_____

State of Arkansas
(hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Cooper Creek Watershed, State of Arkansas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Cooper Creek Watershed, State of Arkansas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

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Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 91,658.)

2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures 1 through 9	0	100	942,166
Stream Channel Improvement and Appurtenances	0	100	39,868

The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Floodwater Retarding Structures 1 through 9	0	100	254,361
Stream Channel Improvement and Appurtenances	0	100	10,763

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 4,965 .)

6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

13. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.13), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

Lawrence County Soil and
Water Conservation District
Local Organization

By E. B. Sloan

Title Chairman

Date March 24, 1965

The signing of this agreement was authorized by a resolution of the governing body of the Lawrence County Soil and Water Conservation District
Local Organization
adopted at a meeting held on March 24, 1965

R. A. Mosley
(Secretary, Local Organization)

Date March 24, 1965

Cooper Creek Watershed
Improvement District
Local Organization

By William H. Slade

Title Chairman

Date March 24, 1965

The signing of this agreement was authorized by a resolution of the governing body of the Cooper Creek Watershed Improvement District
Local Organization
adopted at a meeting held on March 22, 1965

Boyce Durham
(Secretary, Local Organization)

Date March 24, 1965

Soil Conservation Service
United States Department of Agriculture

By _____
Administrator

Date _____

WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

COOPER CREEK WATERSHED
Lawrence County, Arkansas

Under the Authority of The Watershed
Protection and Flood Prevention Act,
(Public Law 566, 83rd Congress, 68
Stat. 666, as amended)

Prepared By:

Lawrence County Soil and Water Conservation District
(Cosponsor)

Cooper Creek Watershed Improvement District
(Cosponsor)

With Assistance By:

United States Department of Agriculture
Soil Conservation Service
Forest Service

September 1964

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WATERSHED WORK PLAN

COOPER CREEK WATERSHED
Lawrence County, Arkansas
September 1964

SUMMARY OF PLAN

General Summary

This work plan for watershed protection and flood prevention for the Cooper Creek Watershed was prepared by the Cooper Creek Watershed Improvement District and the Lawrence County Soil and Water Conservation District, as cosponsoring local organizations. Technical assistance was furnished by the United States Department of Agriculture, Soil Conservation Service and Forest Service.

Cooper Creek Watershed, a 40,128-acre area, is located in western Lawrence County. It is bound on the north by Wells and Harding Creeks; on the east by Chaplin, Brush, Flat, and Cypress Creeks; and on the south and west by the Strawberry River. The two main streams of the watershed, Cooper and Dry Creeks, outlet separately into the Strawberry River.

The total population is 1,053; 767 rural and 286 in the two incorporated communities of the watershed, Lynn and Smithville.

There are 340 farms in the watershed averaging 118 acres each. The 74 farms in the watershed flood plain and the 12 farms located along the Strawberry River and outside the watershed are damaged by floodwater produced in the Cooper Creek Watershed. The watershed flood plain is a 2,740-acre area delineated by the 20-year flood event. During the 20-year period, 1932 to 1951, there were 60 major floods and 54 minor floods which produced average annual flood damages of $56,356. This figure includes scour damage which occurs each year and is estimated to be $4,581, annually. The average annual rate of soil loss is 12.6 tons per acre in the upland.

The county has been declared eligible for ARA assistance due to a high percentage of low-income families and the existence of substantial and persistent unemployment and underemployment.

The local Rural Areas Development efforts to overcome the poor economic conditions have included the formation of a county council to coordinate technical, financial, and other assistance available through a local technical action panel consisting of key federal and state agricultural agencies. An Overall Economic Development Plan has been prepared for the county.

The work plan proposes works of improvement for the watershed to be accomplished during a 5-year installation period at a total estimated cost of $1,556,928. Of this total, $1,274,008 will be borne by Public Law 566 funds and $282,920 by other funds.

Landowners and operators will install land treatment measures which will have a measurable effect on the reduction of floodwater, erosion, and sediment damages. The cost of these measures is estimated to be $213,147. This includes $26,850 of Public Law 566 funds and $186,297 of other funds.

Local interests, in recent years, have provided land treatment which has cost approximately $60,245.

Structural measures consist of nine floodwater retarding structures and 19,850 feet of stream channel improvement, with appurtenances. The total estimated cost of these measures is $1,343,781; the share from Public Law 566 funds is $1,247,158 and the share from other sources is $96,623.

The average annual benefits accruing to structural measures are distributed as follows:

Flood Prevention	
Damage Reduction	$32,432
Changed Land Use	19,547
Incidental Recreation	5,258
Secondary	6,754
Redevelopment	2,220
TOTAL	$66,211

The average annual cost of structural measures is estimated to be $46,642. The ratio of average annual benefits to the average annual cost of structural measures is 1.4 to 1.

Landowners and operators, with assistance from the Agricultural Conservation Program and other federal and state agencies, will install and maintain the land treatment measures.

The Cooper Creek Watershed Improvement District, which has the powers of taxation and eminent domain, has sent a letter of intent to borrow to the Farmers Home Administration. Funds obtained from this loan will be used to finance the local share of the installation cost of structural measures. Revenue from assessments on the benefited land will be used to repay the loan and to operate and maintain the structural measures.

DESCRIPTION OF THE WATERSHED

Physical Data

Cooper Creek Watershed is located in northeastern Arkansas in the western part of Lawrence County. The communities of Lynn and Smithville are in the watershed area. Walnut Ridge, the county seat of Lawrence County, is located approximately 20 miles east of the watershed.

The watershed contains 40,128 acres, or 62.7 square miles. It is bound on the north by Wells and Harding Creeks; on the east by Chaplin, Brush, Flat, and Cypress Creeks; and on the south and west by the Strawberry River. The watershed outlets into the Strawberry River which, in turn, flows into the Black River. The two main streams of the watershed are Cooper Creek and Dry Creek. Dry Creek drains 4,582 acres of the southeastern portion of the watershed and likewise drains into the Strawberry River. About 94.6 percent of the watershed is hill land and the remaining 5.4 percent is bottomland. An additional 553 acres of the bottomland outside the watershed was considered in project evaluation.

Most of the topography of the watershed is developed over limestone and dolomite ridges of the Ozark Mountain Physiographic Province. The Dry Creek drainage area is in the foothill transition area from Ozark Mountains to younger coastal plain deposits. The northern watershed divide is a subtile divide and occurs on a relatively flat highland limestone plateau. Elevations in the watershed range from about 245 feet to 645 feet above mean sea level. The two major land resource areas in the watershed uplands are the Ozark Highlands and the Southern Mississippi Valley Silty Upland areas which occupy 82 percent and 13 percent of the watershed, respectively.

The watershed is underlain by limestones, dolomites, and sandstones of Ordovician Age and unconsolidated sedimentary deposits of Tertiary, Quaternary, and Recent Ages. The older consolidated rock units have been mildly folded and faulted by ancient geologic uplift and occur mainly in the Ozark Highland area. Some of the dolomite and limestone rock units are cavernous and rock outcrops called "cedar glades", locally, are numerous along the upper ridges.

The major soil series in the Ozark Highlands are the Dickson, Nixa, Talbott, and Christian series. These are mostly residual soils developed over limestones and dolomites which have subsequently been capped with loessial deposits in places. The major soil series in the Southern Mississippi Valley Silty Upland are deeper loessial soils which belong to the Grenada and Loring series. This area is underlain, in part, with sandy coastal plain deposits, locally at or near the surface, and are represented by soils such as the Ora and Providence series.

The bottomland soils are chiefly of the Huntington and Elk series. These are deep, well drained, moderately permeable, neutral to acid silty soils. Huntington soils are neutral brown and dark brown silt loam soils on flood plains. The acid Elk soils are on terraces. They have brown silt loam surface soil over yellowish-brown silty clay loam subsoil.

The entire watershed is in private ownership. The land use is as follows:

Land Use	Acres	Percent
Cropland	2,055	5
Grassland	8,106	20
Woodland	27,185	68
Idle	1,992	5
Miscellaneous	790	2
TOTAL	40,128	100

The land use of the 2,055 acres in cropland is as follows: soybeans, 38 percent; corn, 46 percent; small grain, 13 percent; and vegetables, 3 percent.

All but 70 acres of the 27,185 acres of the woodland are in the upland. All woodland is in private ownership with no commercial lumber companies active in the area. Cover types are hardwoods, 96 percent, and red cedar, 4 percent. Most pole and sawtimber-size hardwoods are culls with potential merchantable timber existing mostly as seedlings and saplings. The relative hydrologic condition on 91 percent of the woodland in the upland is poor to very poor, and the potential for improving the hydrologic condition is considered to be low on 78 percent of this area.

Deer, bobwhites, rabbits, and squirrels are the principal game species within the watershed. Numerous doves are present, principally in the lower bottomlands but are not hunted extensively. A few ducks stop off in the numerous farm ponds but do not stay long due to the lack of adequate food supplies. Wildlife resources are generally at a low ebb due to changing land use patterns, although deer are increasing as more former open land in the hills reverts to woodland.

Fish resources are confined to smallmouth bass, rock bass, and long-eared sunfish in Cooper Creek and the sport fish in the farm ponds. The Cooper Creek fishery is of limited importance due to present flooding conditions and periodic droughts which reduce the stream to shallow inaccessible pools.

The average annual rainfall is 44.51 inches. Although intensive rainfall occurs more frequently in the spring, it may occur in any season.

The average rainfall, by months, in inches, is:

January	4.14	July	3.17
February	3.46	August	3.20
March	3.89	September	3.47
April	4.15	October	3.39
May	4.08	November	3.95
June	3.97	December	3.64

The average frost-free period of 214 days extends from April 7 to November 6. Average temperatures range from 39.3 degrees Fahrenheit in January to 80.7 degrees in July. Recorded extremes vary from 112 degrees above zero to 15 degrees below zero, based on Pocahontas, Arkansas, temperature recordings.

The communities of Lynn and Smithville do not have municipal water supplies. Water for domestic use is obtained from wells, cisterns, and springs. Water for livestock is obtained from wells, streams, and ponds. There are no natural lakes in the watershed. Irrigation practices are not being conducted in the bottomlands at the present time.

Land Treatment Data

The watershed is served by the Soil Conservation Service work unit at Walnut Ridge, Arkansas, which is assisting the Lawrence County Soil and Water Conservation District.

Approximately 10 percent of the land within the watershed is covered by 20 basic conservation plans. About 30 percent of the needed land treatment measures have been applied. Soil surveys within the watershed have been completed only on those areas which are covered by basic conservation plans. Further soil mapping will need to be accomplished as part of the project to enable application of needed land treatment measures.

The major conservation practices of the soil and water conservation district cooperators include conservation cropping systems, cover and green manure crops, crop residue use, pasture and hayland renovation, pasture and hayland planting, farm ponds, and tree planting. The present land use pattern is following a trend toward more conservation but flooding and erosion damages still occur.

Forest fire prevention and suppression, forest management assistance, forest insect and disease control, and cooperation in reforestation are provided private landowners by the Arkansas Forestry Commission, in cooperation with the United States Forest Service. These services are available through various federal-state cooperative forestry programs.

Economic Data

Lawrence County's agricultural income was $8,244,270 in 1959 and was of major importance in the total personal income of the county. Agriculture will continue to be an important part of the economy of Lawrence County. The Black River divides the county into distinct agricultural types. The western section is rolling hills, best suited for pasture and livestock production. The eastern portion is more fertile, level to moderately rolling, mixed bottomland-type soils, and is well adapted to field crop production.

The number of farms in the county has declined in recent years, as a result of small farm owners selling or renting their farms to larger farming units. The following tabulation indicates this change has occurred to a lesser degree than the average for the state as a whole.

Number and Size of Farms and Cropland Harvested

	COUNTY			STATE
	1959	1954	Percent Change 1954 to 1959	Percent Change 1954 to 1959
Number of farms	1,424	1,777	- 19.3	- 34.5
Farm Size	194.7	150.3	+ 29.5	+ 40.0
Cropland harvested	112,689	114,106	- 1.2	- 3.8

Source: U. S. Census of Agriculture, 1954 and 1959.

Major crops grown are cotton, soybeans, and corn.

In 1959, 69 percent of the county's farms were classed as commercial as compared with 77 percent in 1954.

Field crops accounted for 77 percent of the agricultural income in the county in 1959. These crops will continue as a major source of income in the county since the area is well adapted to this type of farming. Livestock and livestock products, another leading farm-income activity, should continue to increase.

Soybean acreage, the second ranked field crop, has increased rapidly from less than 7,000 acres in 1949 to almost 75,000 acres at present. The recent development of locally-adapted varieties of soybeans has been an important factor in the acreage increase. The increase in soybean acreage has occurred mostly on land formerly used for cotton and feed production.

Corn, once an important crop in Lawrence County, has declined and will probably continue to do so. Small grains have been relatively unimportant.

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Livestock is of major importance in western Lawrence County. Beef cattle numbers have varied between 10,000 to 12,000 head. The most common type of beef cattle operation is production of high quality feeder calves. There are also a few purebred herds which are used as breeding stock for commercial producers.

Dairy production is at a low level in the county with only five grade "A" dairies selling to a plant in Paragould, Arkansas, and a few grade "C" producers selling to plants at Batesville, Arkansas.

The number of farms selling table eggs declined from 677 in 1954 to 349 in 1959. Between these two periods, the number of chickens on farms advanced almost 17 percent, with the number of eggs produced increasing from 196,325 dozen to 747,063 dozen, a gain of over 280 percent. This shows the effect of many small-volume producers being replaced by a few large producers. Under present market conditions, this type of shift can be expected to continue.

Hired workers in county agricultural occupations totaled 520 in 1959 for a loss of 65 percent since 1954. The state decrease was comparatively less, decreasing only 46 percent.

Walnut Ridge (population 3,550) is the nearest trade center for the county. It is located approximately 20 miles east of the watershed.

Walnut Ridge offers many services to the rural community such as: (1) health facilities, county hospital; (2) communications, newspaper and radio station; (3) transportation, railroad service, hard-surfaced state highways, motor freight carriers, and bus company; (4) education, grade and high schools; and (5) social interests, churches, city parks, and a recreation program for youth.

Walnut Ridge also provides retail, wholesale, and professional services which are generally associated with an agricultural economy.

There are two national banks and one state-chartered bank in Lawrence County. Their total resources are in excess of $9,000,000.

There are 140 miles of federal and state highways traversing the county. All state and federal highways in the county are paved with the exception of 33 miles of state highway. There are 808 miles of county roads, with 36 being hard-surfaced.

Commercial passenger and freight air transportation is available through the Jones Airport (Craighead County) about 25 miles east of Walnut Ridge.

The population of the county reached its peak of 22,651 in 1940. Since 1940, out-migration reduced the number of residents to 21,303 in 1950 down to 17,267 by 1960. Most of the population decline in recent years

occurred in the rural farm section. From 1930 to 1960, only the rural nonfarm population section of the area reported an increase. While the rural farm section decreased 62 percent, the number of rural nonfarm residents increased 16 percent. Walnut Ridge, the area's only defined urban center, had an increase in population of 14 percent.

According to U. S. Census information, there were 5,204 persons in the April 1960 civilian labor force. This was a 21.5 percent reduction from the April 1950 level. There were 4,872 workers employed in the county in April 1960. This was 23.3 percent fewer than the number employed during the April 1950 census period. During early 1963, Arkansas Employment Security Division's Smaller Communities Program made a study to determine the area's current and potential manpower resources. A total of 1,467 persons filed applications. Forty-one percent were employed and fifty-nine percent were unemployed. Of the 590 employed, 301 were underemployed.

The long-term decline in the area's agricultural employment greatly affected the unemployment problem. The 1950-1960 census decline in employment represented a lack of jobs for over 1,500 agricultural workers. Despite substantial outmigration of workers which resulted in a net loss of 54 percent of the rural farm population from 1950 to 1960, there remained a surplus of labor.

The economy of the 1,389 farms in the county is not strong with 64 percent of the farms having a gross sale of less than $5,000. About 39 percent of the farmers work off the farm to supplement their farm income, with 21 percent working off the farm 100 days or more.

The county has been declared eligible for ARA assistance due to a high percentage of low-income families and the existence of substantial and persistent unemployment and underemployment.

The local Rural Areas Development efforts to overcome the poor economic conditions have included the formation of a county council to coordinate technical, financial, and other assistance available through a local technical action panel consisting of key federal and state agricultural agencies. An Overall Economic Development Plan has been prepared for the county.

Because of its geographic location, Lawrence County has a promising tourist potential. The natural beauty of the area's rivers and lakes is attractive and has potential for outdoor activities such as hunting, fishing, and water sports.

There are two incorporated communities in the watershed: Lynn, population 196; and Smithville, population 90. The total population of the watershed is 1,053. There are 340 farm owners and operators in the area and most farms are owner-operated. The members of some families are employed at Walnut Ridge.

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Cooper Creek Watershed is similar in most respects to the western half of Lawrence County.

The average farm consists of 118 acres of land, dwellings, and other essential buildings. The average value per farm is $13,500.

This area does not have the community facilities, private capital, and social amenities which would make it a desirable place for the location of industrial economic activities; however, there is considerable evidence of a real desire for the residents to maintain and improve their community and their standard of living. This is evidenced by some well-kept farmsteads, new capital improvements such as dwellings, fences, barns, etc. Lynn and Smithville just recently incorporated in order to take steps toward increasing community facilities and services.

The economy of the watershed is principally agricultural, with the production of feeder calves providing the major source of income. There are three dairy farmers, one large commercial egg producer, and a few producers of feeder pigs. The fertile creek bottomlands are being used intensively for the production if improved pasture, meadow, corn, soybeans, etc.

In 1961, okra and cucumbers were introduced in the southern portion of the watershed. In 1963, there were 50 acres of okra and cucumbers grown. The development of a market and the introduction of these types of enterprises are important to this area. Labor is one underemployed resource which can be well utilized in the production of vegetables. The desired increased self-employment of family labor cannot be expected without the introduction of compatible enterprises into the existing farm system. The only other alternative to increase employment would involve the retraining of families and, in some cases, moving them to a place of employment. The social adjustment and problems created in the moving of families, in many instances, outweighs the benefits.

WATERSHED PROBLEMS

Floodwater Damage

Floodwater damages are listed in order of their importance as follows: crop and pasture; other agricultural; indirect, and nonagricultural. The flood-plain area in agricultural use is the principal area where these damages occur. The largest flood in a 20-year period was used to delineate the flood-plain area of 2,740 acres.

The June 1950 flood is a typical major spring flood. The estimated damages resulting from this storm are as follows: crop and pasture, $32,408; other agricultural, $2,681; and nonagricultural, $2,431. The acres inundated by this storm were estimated to be 2,088.

Based on the 20-year rainfall records used to evaluate the agricultural damages, there were 60 major floods which inundated at least 50 percent of the flood plain. Of these floods, 27 percent occurred in the spring when crops were most susceptible to damage. The following table gives the number of floods by winter and spring seasons:

Evaluation Reach	20 Years No. Damaging Floods: Total	20 Years No. Damaging Floods: Major Floods 1/	Floods - Winter and Spring: Number by Season: Winter	Floods - Winter and Spring: Number by Season: Spring	Floods - Winter and Spring: Major Floods: Winter	Floods - Winter and Spring: Major Floods: Spring
1	122	60	31	34	24	16
2	124	60	31	35	24	16
3	124	60	31	35	24	16
4	82	60	29	23	24	16
5	118	60	31	33	24	16
TOTAL 2/	114	60	31	32	24	16

1/ Inundates 50 percent or more of the flood plain.
2/ Weighted by number of acres in flood plain.

The above table reflects that there is an average of almost six damaging floods each year. Approximately one major flood occurs each spring and more than one each winter. Approximately three floods each year are considered major and three are considered minor. The minor less damaging floods cause considerable damage throughout the year. The small frequently inundated areas are generally considered a liability to the farm business. The average annual acres flooded is estimated to be 7,847 acres. The average annual acres inundated by the smaller floods are approximately 20 percent of the total acres inundated, annually.

The lower parts of reaches 2 and 5 and all of reaches 3, 4, and 6 are affected by flooding from the Strawberry River. In reaches 2, 3, and 5, the flooding caused by Strawberry River was measured separately from that caused by Cooper Creek. In addition to the above table, the following information concerns the separate effects of flooding from Strawberry River. In reach 2, there were 43 floods, 19 winter and 16 spring, for an average of 2 per year. None of these floods inundated enough area to be considered a major flood. In reaches 3 and 5, there were 64 floods, 28 winter and 21 spring, for an average of 3 per year. Only 6 of these inundated enough area to be considered major floods.

Damage to crop and pastureland vary with respect to location within the watershed. The following table reveals the estimated value of flood-plain production, the estimated average annual crop and pasture damage per acre,

and the average annual loss of crops and pasture as a percent of the damageable value:

Reach	Location	Damageable Value Per Acre (dollars)	Without Project: Estimated Annual Crop and Pasture Damage Per Acre (dollars)	Without Project: Percent of Gross Production Damaged Annually
1	Cooper Creek Valley Cross Sections 25 to 13	21.56	4.51	21
2	Cooper Creek Valley Cross Sections 13 to 5	40.87	18.42 2/	45
3	Cooper Creek Valley Cross Sections 5 to 1	45.68	14.55 2/	32
4	East Bank Strawberry River Valley Cross Sections 1 to 05	59.33	12.93 2/	22
5	Dry Creek and Drain 3	53.89	11.97 3/	22
6 1/	West Bank Strawberry River	60.99	13.62 2/	22

1/ Off-site reach - west bank of Strawberry River.
2/ Damages caused by Cooper Creek flooding.
3/ Damages caused by Dry Creek flooding.

The variation in damageable value per acre between reaches may be associated with the inherent fertility and the adaptability to intensive farming methods. Damageable values per acre are lowest in the narrow upland reaches and increase in the lower reaches and larger flood-plain area, particularly the common flood plain of Strawberry River.

The project map shows the relationships of the selected study reaches to the flood plains within the watershed. The lower end of reach 2 and all of reach 3 of Cooper Creek have common flood plain with Strawberry River. Reach 4 is the east bank of Strawberry River between the mouth of Cooper Creek and reach 5. The lower portion of Dry Creek, reach 5, has flood plain common with Strawberry River. All of the above-mentioned evaluation reaches are in the watershed boundary. Reach 6 is the flood plain of Strawberry River directly across the river from reach 4.

The total average annual floodwater damage is estimated to be $46,652, at long-term price levels. Crop and pasture damage accounts for $37,411; other agricultural damage $5,123; and nonagricultural damage $4,118.

Pasture damage, as illustrated in the above photograph, occurs annually.

Evidence of the flood flows across cropland along the main stem of Cooper Creek is shown in the accumulation of corn field debris in the above photograph. The depth of flooding in this area is indicated by the flood-flow line at the man's left foot in the center of the photograph.

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The forced change in land use has been another agricultural deterrent. Crops which have become highly competitive in the market are no longer produced in the flood plain. The added cost attributed to flooding could not be absorbed by the small farmers. Cotton production and cotton gins have completely disappeared from the watershed area. Without flooding, the flood plain could be more intensively used. Crop acres of vegetables such as okra, watermelon, and cucumbers could expand.

Other agricultural damage is limited to fences. Nonagricultural damage is limited to roads and bridges. There are no improvements such as dwellings or farm buildings in the flood plain which indicate the influence and severity of flooding.

Indirect damages can be described as follows: delayed milking of dairy herds; loss of income from not being able to commute to work; increased costs of delayed sales of agricultural products such as milk and eggs; losses in sales of local merchants due to roads being closed; and the increased cost of operating public schools. School children have been separated from their families for as long as three days.

These conditions have an adverse effect on the lives of the people in the area.

The making and realization of long range plans for the development and improvement of the farm business is made more difficult. Making decisions regarding the future of their children and their guidance and training toward adult responsibility becomes more difficult.

Road and bridge damage results annually from floods. This picture illustrates this type of damage from the March 9 and 10, 1964 flood.

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Road and bridge damage results annually from floods. These two pictures illustrate this type of damage from the March 9 and 10, 1964 flood.

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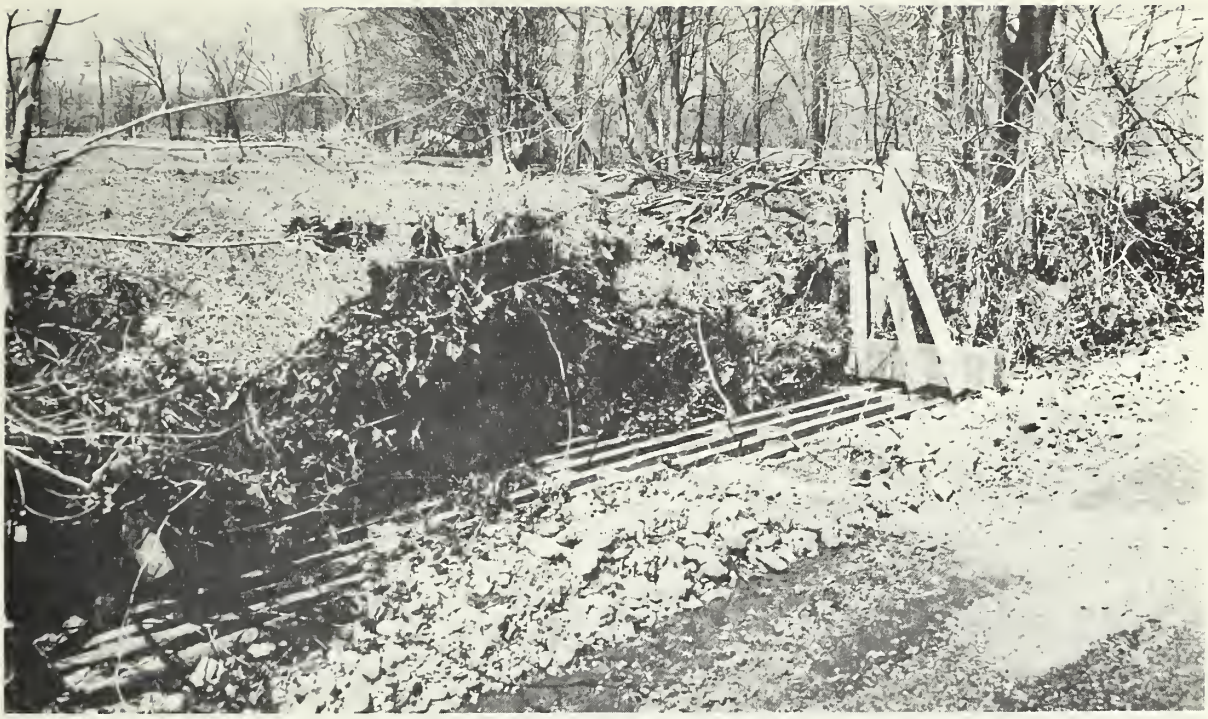

During March 9 and 10, 1964, extensive damage to fences occurred. These two photographs illustrate typical damage to this value.

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Sediment Damage

Each year relatively small acreages of overbank deposition occur along the larger tributaries where the stream gradients change somewhat abruptly or at the confluence of streams. Finer grain sediment is carried further downstream where it lessens channel capacities and induces more flooding on the bottomlands. Swamping is a minor problem. Vegetative debris also causes minor damages to fields, fences, bridges, and channels.

Erosion Damage

Sheet erosion is extensive in the uplands of the watershed. The present weighted average annual rate of erosion is 12.6 tons per acre in the uplands. Gully and road erosion have been a more serious problem in the past than they are now. Most of the gullies are fairly well healed by vegetation. Approximately two-thirds of the uplands soils have experienced erosion to the extent that it affected the soil fertility. Poor forest conditions and steep slopes cause considerable sheet erosion in the northern portion of the uplands whereas extensive row cropping causes sheet erosion in the uplands of the Dry Creek area. Conversion of land that once was cultivated to pasture and range in the uplands throughout the watershed has already reduced the rate of erosion to much less than it once was.

Flood-plain scour has had a dual effect on the bottomland agricultural economy. It has removed the more productive topsoil from 1,302 acres of land and it has forced the farmers to convert some of this area from crop production to pasture. It is most damaging on newly plowed fields which are flooded in the spring at the time of land preparation. A few of the scour channels in reaches 2 and 3 interfere with mechanical farm operations. A breakdown of the area damaged by flood-plain scour indicates that 737 acres are damaged from 20 to 30 percent and 565 acres are damaged 30 percent or more. The average annual scour damage, without a project, is estimated to be $4,581.

Streambank erosion is not a serious watershed problem. Eddying has caused some erosion below several of the bridges and Dry Creek is eroding some 1,800 feet of a county road north of the community of Lynn. Small acreages of land voiding do occur in the flood plain, but the rates of growth appear to be low.

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Main-stem scour damage to cropland following flooding of March 9 and 10, 1964.

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Problems Relating to Water Management

There is no indication of a need for drainage in the watershed. Irrigation of crops is of minor importance and irrigation facilities are not needed to adequately develop the watershed. Individual farm water supplies are obtained from wells, cisterns, ponds, and springs. Water for human use is expensive and difficult to obtain. The communities of Lynn and Smithville are in need of municipal water supplies.

PROJECTS OF OTHER AGENCIES

The Cooper Creek Watershed is located in the White River Watershed. Congress, through the passage of the Flood Control Act of 1938, approved the construction of six reservoirs on the White River and its tributaries as a part of a general comprehensive plan for flood control and other purposes in the river basin. The six authorized projects are: Clear Water Reservoir on the Black River in Missouri; Water Valley Reservoir on Eleven Point River in Arkansas and Missouri; Norfork Reservoir on the north fork of the White River in Arkansas and Missouri; Lone Rock Reservoir on the Buffalo River in Arkansas; Greer's Ferry Reservoir on the Little Red River in Arkansas; and Bell-Foley Reservoir on the Strawberry River in Arkansas. The Flood Control Act of 1941 and 1954 modified the plan to first add on the White River the Bull Shoals and Table Rock Reservoirs in Missouri and Arkansas, and then Beaver Reservoir in Arkansas.

The Bull Shoals, Norfork, Clear Water, Table Rock, and Greer's Ferry Reservoirs are essentially complete, and Beaver Reservoir is under construction.

The modification of the White River system with specific reference to the effects of the flows on the outlet, Strawberry River, was used in evaluating this project. The construction of the authorized Bell-Foley Reservoir, located about nine miles upstream from Cooper Creek Watershed would result in a significant modification of Strawberry River at the watershed outlet. Due to the indefinite status of plans to install the Bell-Foley project, the effects of this project were not considered in evaluating the Cooper Creek Watershed.

A local levee district has not been organized to construct and maintain local improvements for protection against the flooding of the Strawberry River on the common flood plain of the Strawberry River and Cooper Creek.

BASIS FOR PROJECT FORMULATION

The sponsors of the watershed project recognized the need for a comprehensive approach to their problems. On August 11, 1962, they formed the Cooper Creek Watershed Improvement District under Act 329 of the Acts of the General Assembly of the State of Arkansas for 1949, as amended. The

formation of the improvement district provides the means by which the landowners may collectively assume the local responsibility under Public Law 566 and demonstrates the local group's ability and willingness to assume this responsibility.

Due to the limited amount of potentially productive agricultural land in the watershed, the sponsors felt that a high level of agricultural protection was needed for the flood plain of Cooper Creek and local tributaries. In the Cooper Creek evaluation unit, several combinations of measures were studied: (1) five floodwater retarding structures without channel improvement; (2) five floodwater retarding structures with channel improvement; (3) seven floodwater retarding structures without channel improvement; and (4) seven floodwater retarding structures with channel improvement. Stream channel improvement was necessary to prevent flooding induced by structure releases and provides protection needed to meet the objectives of the sponsors.

The Dry Creek unit is interrelated to the Cooper Creek unit; however, channel improvement to supplement the protection provided by the two floodwater retarding structures of this unit was not found necessary.

The sponsors recognize that the common flood plain area will continue to flood at certain stages on the Strawberry River. They also consider that a structural control program in the Cooper Creek Watershed represents the only feasible and locally acceptable method presently available to protect these fertile lands which are the most highly developed in the watershed.

It was agreed that the nine floodwater retarding structures with channel improvement were needed to meet the project objectives.

The sponsors recognized the basic need for and asked that the plan include land treatment measures which increase the efficiency of land use and provide protection which will insure benefits from the structural measures.

The sponsors expressed an interest in storing additional water for recreation and for municipal use. The proposed structural sites which were located at a feasible distance from the potential user of the municipal water supply, Smithville, and which have adequate drainage areas to support the needed storage, are located in cavernous limestones and dolomites. The cost of treating these sites to assure the retention of the added water for beneficial use was considered excessively expensive. In lieu of a recreational development at a structure site, the local people envisioned a single-purpose recreational development along a stream reach of Cooper Creek just west of Smithville and below floodwater retarding structure numbers 1, 2, and 3. The present policy for administering Public Law 566 projects does not recognize single-purpose recreational projects as being eligible for cost sharing on land and facilities. The sponsors did not feel they were able to bear the entire cost of the recreational project and, for this reason, did not wish to include recreation as a project purpose. The town of Smithville does, however, plan to develop site 4 for incidental recreational use.

The Soil Conservation Service and the sponsors agree on the need for developing watershed resources and agree that the plan, as formulated, provides for all reasonable and feasible development to meet the objectives of the sponsors.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Lawrence County Soil and Water Conservation District has been conducting a conservation program with soil and water conservation district cooperators in the watershed. This program, based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs for production and improvement in the chosen land use, is an essential part of watershed protection. The extent of needed land treatment measures which have been applied to date within the watershed represent an expenditure by landowners and operators of approximately $60,245 (table 1A).

The accelerated application and continued maintenance of land treatment measures are important. Without them, the installation of the other work plan features would not produce the expected benefits. For this reason, in addition to the presently available technical assistance, $23,200 will be made available from Public Law 566 funds to accelerate the planning of these practices.

Standard soil surveys will be completed on the watershed area. This will be accomplished by accelerated funds during the installation period at an estimated cost of $3,650.

About 2,230 acres of cropland will be treated with a combination of measures including cover and green manure and crop residue use in a conservation cropping system.

About 2,798 acres of grassland will be treated with a combination of measures, including brush and weed control, pasture and hayland renovation, pasture and hayland planting, and pasture proper use.

Approximately 2,650 acres of forest land will be treated for hydrologic stand improvement. Hydrologic stand improvement will be achieved with such measures as interplanting, underplanting with release, release of preferred tree species, improvement cuts, and grazing control.

Approximately 15 farm ponds will be constructed to improve upland stock water supplies.

Structural Measures

The structural measures consist of 9 floodwater retarding structures and 3.76 miles of stream channel improvement (see project map, figure 3).

The installation cost of floodwater retarding structures is estimated at $1,264,265. The cost of the channel and appurtenances is estimated at $79,516.

The total drainage area behind the proposed dams will be 39.3 square miles, representing 62.7 percent of the watershed. The conservation pools reserved for sediment will inundate 62 acres of flood plain. An additional 1,038 acres will be inundated by the structure pools.

The 9 structures will have an aggregate capacity of 16,654 acre-feet. The structures will have a total floodwater detention capacity of 13,312 acre-feet. The sediment storage provided will be adequate for 100-year accumulation. Floodwater detention capacity, expressed in inches of runoff from the drainage area above structures, is 6.34 inches. Sufficient detention storage can be developed at all structure sites to permit the use of vegetative spillways.

Each floodwater structure will include a drawdown slot and a drain valve in the principal spillway. These devices will permit manipulation of water levels for weed and mosquito control. They will also provide for fish management operation, exposure of shallow edges for waterfowl plantings, and the means to supply water downstream for emergency use.

A portion of the stream channel on the main stem of Cooper Creek will be improved to have sufficient capacity to carry the runoff from the principal spillway release of floodwater retarding structure numbers 1 through 5, runoff from the uncontrolled hill land required by the formula $Q = 80M^{.753}$ and runoff from the contributing bottomland required by the formula $Q = 45M^{.576}$. Approximately 14 grade stabilization structures will be installed, as appurtenances of the channel improvement, in ditches and side drains where needed for grade stabilization and erosion control.

The installation of structural measures will result in the relocation of three-fourths of a mile of road, two bridges, raising a short section of Highway 115, and modification of two low-water fords.

The structure and reach locations are shown on figure 3, the project map. Plans for a typical structure are illustrated by figures 2 and 2A. More detailed information on quantities, costs, and design features are given in tables 1, 2, 3, and 3A.

EXPLANATION OF INSTALLATION COSTS

The total installation cost of the project is estimated to be $1,556,928, of which $1,274,008 will be paid from Public Law 566 funds and $282,920 will be borne by other funds. Included in total costs are land treatment measures, $213,147, and structural measures, $1,343,781.

Land treatment costs will be shared $26,850 by Public Law 566 funds and $186,297 by other funds. Other funds include $11,950 for technical

assistance through the regular program of Public Law 46, and $5,700 in State funds for technical forestry assistance provided by the Arkansas Forestry Commission.

To accelerate the installation of land treatment measures, Public Law 566 funds will pay $3,650 for soil surveys and $15,000 for other technical assistance by the Soil Conservation Service and $8,200 for technical forestry assistance by the Arkansas Forestry Commission in cooperation with the United States Forest Service.

All costs of structural measures are allocated solely to flood prevention. Public Law 566 funds will pay all construction and installation service costs on these structures. The remaining costs will be borne by other funds.

Structural measures costs will be shared $1,247,158 by Public Law 566 funds, and $96,623 by other funds. The Public Law 566 funds will be spent for construction and installation services costs for the 9 floodwater retarding structures and 3.76 miles of stream channel improvement.

Public Law 566 funds will include $982,034 for construction costs and $265,124 for installation services. Other funds will include $4,965 for administration of contracts, and $91,658 for easements and rights-of-way. Included in easements and rights-of-way costs to be paid from other funds are $17,200 for road and bridge relocation, $2,440 in legal fees, and $72,018 for lands.

The engineer's cost estimate and contingency allowance of 10 percent is considered realistic and provides a reasonable allowance for unexpected costs.

The estimated schedule of obligations for the 5-year installation period covering the installation of both land treatment and structural measures is as follows:

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Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
First	Land Treatment	4,000	37,260	41,260
	Installation Services	24,656	-	24,656
Second	Land Treatment	5,000	37,260	42,260
	Structures 8 and 9	91,638	11,937	103,575
Third	Land Treatment	7,000	37,260	44,260
	Structures 4, 5, 6, 7, and Channel Improvement	438,258	57,136	495,394
Fourth	Land Treatment	7,000	37,260	44,260
	Structures 1, 2, and 3	692,606	27,550	720,156
Fifth	Land Treatment	3,850	37,257	41,107
	TOTAL	1,274,008	282,920	1,556,928

EFFECTS OF WORKS OF IMPROVEMENT

After the installation of the combined program of land treatment and structural measures, 2,740 acres of flood-plain land will be benefited.

The project will directly benefit the owners and operators of 340 farms within the watershed and the 74 farms in the flood plain will receive direct flood prevention benefits. As the result of project installation, approximately 12 farms located outside of the watershed (directly across the Strawberry River) will receive crop and pasture damage reduction benefits.

Upon the installation of the combined program of land treatment and structural measures, average annual acres inundated within the watershed will be reduced from 6,349 to 2,353, or 63 percent. The following table presents the reduction in average annual acres inundated for each evaluation reach:

Reach Number (Figure 3)	Average Annual Acres Inundated: Without Project	With Project	Reduction	Percent Reduction
1	717	235	482	67
2	2,021	510	1,511	75
3	1,491	327	1,164	78
5	867	296	571	66
4 1/	1,253	985	268	21
Subtotal	6,349	2,353	3,996	63
6 2/	1,498	1,244	254	17
TOTAL	7,847	3,597	4,250	54

1/ East Bank Strawberry River between Cooper Creek and Dry Fork Creek.
2/ West Bank Strawberry River between Cooper Creek and Dry Fork Creek, outside watershed.

In the 20-year period used to evaluate flood-plain damages, there were 60 major floods and 54 minor floods. As a result of the installation of land treatment and the proposed structural measures, 40 (67 percent) of the major floods will be reduced to minor floods. Thirty-four (69 percent) of the minor floods will be completely eliminated.

At the foot of evaluation reach 2, installation of the structures would reduce the April 14, 1945 flood (the largest flood during the spring of the historical series, 1932 to 1951), from a 20-year frequency discharge of 19,500 c.f.s. to 5,650 c.f.s.; consequently, acres inundated, excluding Strawberry River, would be reduced from 1,703 to 1,000 acres, or 42 percent.

Gross erosion from the upland area will be reduced from 12.61 tons to 9.74 tons, or about 23 percent, annually, from the establishment of land treatment measures only. Effects of past scour will be reduced; but, more significantly, scour, itself, will be virtually eliminated in the future.

Incidental recreational benefits are expected to accrue to the floodwater retarding structures. Based on experiences of similar watershed projects in Arkansas, the 191 acres of newly impounded water will substantially enhance recreational use of the area. Fishing, swimming, frog gigging, camping and picnicking, boating, and hunting will be the chief recreational uses of the reservoir areas. It is anticipated that a number of cabins and vacation homes will be built above the flood pools of the impoundments.

The 15 farm ponds installed along with the project will provide additional recreational benefits to the individual farm owners.

The following annual recreational use of the Cooper Creek Watershed is anticipated:

Sightseeing	7,125 man-days
Fishing	5,250 man-days
Swimming	1,100 man-days
Frog Gigging	975 man-days
Camping and Picnicking	850 man-days
Boating	200 man-days
Waterfowl Hunting	105 man-days

The spring season is expected to afford the peak visitor use to the area when between 30 and 40 visitors per day will participate in recreation activities.

Secondary benefits accruing as a result of the project will be obtained from increased sales and services by retailers, processors, and transporters of agricultural products. The expanded agricultural production will require increased purchases of items used in agricultural production and will enable residents to increase expenditures for items that reflect the level of living. Benefits will be realized also from increased sales of items associated with business opportunities induced by the project. These will include items necessary for the enjoyment of recreational activities, including the development of basic facilities.

After installation of the project, damage to roads and bridges in the flood plain will be reduced greatly. This reduction in flood damage will enable the county to provide better road maintenance and will release funds from repair of damage to use for road and bridge improvement. As a result, transportation within the watershed will be much improved.

High value crops will replace some of the acreage of comparatively low value crops now grown because the frequency of flooding and acres inundated will be reduced.

Damage to fences will be greatly reduced after the project is installed.

The total effects of the proposed project will give the residents a greater sense of security. They can offer their children greater incentives to continue their education and remain in the community to make their livelihood. These effects should help reverse the trend in population loss. The farm-family pattern of agriculture will thereby be strengthened.

An immediate stimulus to the economy will result from the increase in employment resulting from the construction of the proposed project. The local labor employed in the installation of the project will primarily be underemployed small farm operators.

Operation and maintenance of the project will provide employment for some unemployed and underemployed residents of the watershed.

PROJECT BENEFITS

The estimated average annual monetary floodwater, erosion, and indirect damages (table 5) will be reduced from $56,365 to $21,409 by the proposed project. This is a reduction of 62 percent, 92 percent of which results from the system of structural measures.

Reductions of flood damages vary with respect to location within the watershed. The following tabulation shows the locations of the damage reduction benefits attributed to the combined program of land treatment and Public Law 566 structural measures:

Evaluation: Reach 1/	Location	Without Project (dollars)	With Project (dollars)	Percent Reduction
1	Upper part Cooper Creek	4,391	870	80
2	Mill Creek and middle part Cooper Creek	19,764	4,221	79
3	Lower part Cooper Creek	10,785	2,671	75
4 2/	East bank Strawberry River	7,313	5,897	19
5	Dry Creek	5,846	1,083	81
6 3/	West bank Strawberry River	8,257	6,667	19
TOTAL		56,356	21,409	62

1/ As shown on project map (figure 3).
2/ Strawberry River flood plain within the watershed boundary.
3/ Strawberry River flood plain outside the watershed boundary.

Damage reduction benefits resulting from the installation of land treatment measures will approximate $2,515, annually. These benefits were not used for project justification.

Benefits from changed land use of agricultural land, as a result of flood protection, are estimated to average $19,547, annually (table A).

Incidental recreational gross benefits from use of the sediment pools of the 9 floodwater retarding structures are estimated to approximate $7,800, annually, over the project life. Annual associated cost of $2,542 reduces

this benefit to $5,258. This estimate is based on a benefit accrual over 50 years converted to an annual equivalent for 100 years.

Since Lawrence County has been designated under the Area Redevelopment Act as an area of serious and chronic unemployment, redevelopment benefits were calculated and used in project justification. The average annual value of redevelopment benefits is estimated to be $2,220.

Local secondary benefits were used in project justification. Such benefits resulting from the flood prevention and recreational features of the project will amount to about $6,754, annually. Secondary benefits from the national viewpoint were not considered pertinent to project evaluation.

It is estimated that primary benefits from the structural measures will average $59,457, annually. Addition of the secondary benefits will raise the total to $66,211, annually.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of the structural measures (amortized total installation cost plus operation and maintenance) is estimated to be $46,642. The structural measures are expected to produce average annual primary benefits of $59,457, or $1.27 for each dollar of cost. The ratio of total average annual benefits ($66,211) to the average annual cost of structural measures ($46,642) is 1.4 to 1 (table 6).

PROJECT INSTALLATION

The watershed project is planned for a 5-year installation period. Land treatment measures will be established throughout the entire period by farmers in cooperation with the local soil and water conservation district. The soil and water conservation district, with additional technical help from the Soil Conservation Service and the Arkansas Forestry Commission, in cooperation with the United States Forest Service, will assist with the planning and application of these measures. This assistance will be accelerated to assure application of planned measures within the project installation period. The Soil Conservation Service will provide the additional technical assistance for conservation planning, land use determination, and application assistance for cropland, pastureland, rangeland, and wildlife land practices. The Arkansas Forestry Commission, in cooperation with the United States Forest Service, will assign foresters who have been trained in watershed management to help install the planned woodland measures. The foresters will schedule their work during the installation period to insure the maximum benefits to the watershed project.

The Lawrence County Soil and Water Conservation District will assume active leadership in getting the land treatment program installed. The supervisors of the soil and water conservation district, by scheduled meetings and individual contacts, will encourage watershed farmers to establish complete soil and water conservation programs on their farms.

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The Lawrence County Agricultural Stabilization and Conservation Committee will cooperate with the governing body of the soil and water conservation district by selecting those ACP practices which will accomplish the conservation objectives in the shortest possible time.

The Agricultural Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings, preparing radio, television, and press releases, and using other methods of getting information to the watershed landowners and operators.

Structural measures will be established throughout the entire installation period. The installation of structural measures will require the acquisition of appropriate land, easements, and rights-of-way for all structural measures.

The Cooper Creek Watershed Improvement District was formed under the authority of Act 329 of the Acts of the General Assembly of the State of Arkansas, and has all the necessary rights to discharge local responsibility.

All structural measures are in one construction unit. The installation of these measures will be contingent upon the following conditions:

1. Adequate land treatment above the floodwater retarding structures has been installed either before or concurrently with the installation of the structural measures.

2. All land, easements, and rights-of-way have been obtained for structural measures or a substantial part have been obtained; and a written statement has been furnished by the improvement district that its right of eminent domain will be used, if needed, to secure the remainder within the project installation period and that sufficient funds are available for this purpose.

3. The contracting agency is prepared to discharge its responsibility as contracting agency.

4. The project agreements have been executed.

5. Operation and maintenance agreements have been executed.

The Soil Conservation Service will provide technical assistance in planning, design, preparation of contract payment estimates, final inspections, execution of certificates of completion, and related tasks for the establishment of the planned structural measures.

Fish and wildlife conditions will be improved by a combination of watershed activities and improvements. The impounded surface water of the 9 project reservoirs will make a substantial contribution to the development of this

area for waterfowl. As structures are completed, existing water will be treated with rotenone to eliminate undesirable native fish. Sport fish to stock the impoundments will be ordered by the soil and water conservation district through the United States Fish and Wildlife Service. Fish management plans will be set up for each body of water.

The sponsors will make a concerted effort to interest local landowners in establishing additional wildlife food and cover plants that will benefit bobwhites, deer, rabbits, and doves. It is anticipated that 22 acres will be developed for this purpose.

Good fish management programs in newly built farm ponds and in existing ponds suitable for renovation will be stressed as part of the accelerated assistance to district cooperators.

FINANCING PROJECT INSTALLATION

Federal assistance will be provided under authority of The Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended. This assistance is subject to appropriation of funds.

The cost of land treatment measures will be financed by the owners and operators of the land with aid from the Agricultural Conservation Program and other state and federal programs. The technical application assistance for the forest land treatment measures will be financed by the Arkansas Forestry Commission and Public Law 566 funds provided through the United States Forest Service. If the state is unable to furnish the funds for the first year of project installation, Public Law 566 funds may provide the entire cost with the cost shared during the remainder of the installation period. The technical assistance cost for conservation planning, land use determination, application assistance for cropland, pasture, and wildlife practices will be financed from the going Soil Conservation Service program (Public Law 46) and Public Law 566 funds. Public Law 566 funds are provided for only the acceleration of needed land treatment.

The Cooper Creek Watershed Improvement District which has the powers, under state law, to secure and repay loans, assess benefits, and levy taxes, will provide local funds needed in the installation of structural measures. The improvement district has filed a letter of intent to borrow with the Farmers Home Administration, Little Rock, Arkansas. The monies obtained from this loan will be used to carry out the local obligations in installing the planned structural measures. Funds for the repayment of the loan will be obtained from taxes levied on the benefited area.

Public Law 566 funds will finance the construction cost and installation services costs incurred by the Soil Conservation Service in the installation of structural measures.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators, cooperating with the local soil and water conservation district. Representatives of the district and the Soil Conservation Service will make periodic inspections of land treatment measures and the district will encourage farmers to perform needed maintenance.

Structural measures will be operated and maintained at an estimated annual cost of $2,620 (based on long-term price levels) by the Cooper Creek Watershed Improvement District. Funds for paying maintenance costs will be obtained from taxes levied on the benefited area. Maintenance will be done with contributed labor, district-owned equipment, by contract or force account, or a combination of these methods. The need for maintenance will be determined by inspections at least annually and as needed. The section of stream channel improvement will be included in the inspection to determine the need for control of vegetation, bank stabilization, and removal of sediment and debris which affects the channel capacity. The inspection of the floodwater retarding structures will include the condition of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and the emergency spillway, fences, and gates installed as part of the structures.

Provision will be made for free access of representatives of the sponsoring local organizations and federal agencies to inspect and for the watershed improvement district to provide maintenance for structural measures and their appurtenances at any time.

The sponsoring local organizations will maintain a record of all maintenance inspections and maintenance performed and have the record available for inspection by the Soil Conservation Service. They fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitations to bid on the construction of the structural measures.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Cooper Creek Watershed, Arkansas

Installation Cost Item	Unit	Number to be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other Funds	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	2,353	-	17,862	17,862
Pastureland	Acre	1,131	-	77,735	77,735
Rangeland	Acre	1,099	-	6,500	6,500
Wildlife Land	Acre	240	-	8,150	8,150
Technical Assistance			15,000	11,950	26,950
Soil Survey			3,650	-	3,650
SCS Subtotal			18,650	122,197	140,847
Forest Service					
Woodland	Acre	2,650	-	58,400	58,400
Technical Assistance			8,200	5,700	13,900
FS Subtotal			8,200	64,100	72,300
TOTAL LAND TREATMENT			26,850	186,297	213,147
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	9	942,166	-	942,166
Stream Channel Improvement and Appurtenances	Feet	19,850	39,868	-	39,868
SCS Subtotal			982,034	-	982,034
Subtotal - Construction			982,034	-	982,034
Installation Services					
Soil Conservation Service					
Engineering Services			176,767	-	176,767
Other			88,357	-	88,357
SCS Subtotal			265,124	-	265,124
Subtotal - Installation Services			265,124	-	265,124
Other Costs					
Land, Easements, and Rights-of-Way			-	91,658	91,658
Administration of Contracts			-	4,965	4,965
Subtotal - Other			-	96,623	96,623
TOTAL STRUCTURAL MEASURES			1,247,158	96,623	1,343,781
TOTAL PROJECT			1,274,008	282,920	1,556,928
SUMMARY					
Subtotal SCS			1,265,808	223,870	1,489,678
Subtotal FS			8,200	59,050	67,250
TOTAL PROJECT			1,274,008	282,920	1,556,928

1/ Price Bases: 1963 and 1964.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(at time of work plan preparation)

Cooper Creek Watershed, Arkansas

Measures	Unit	Number Applied to Date	Total Cost 1/
LAND TREATMENT			
Conservation Cropping System	Acre	1,000	2,750
Cover and Green Manure Crop	Acre	1,000	7,500
Crop Residue Use	Acre	1,998	4,995
Pasture and Hayland Renovation	Acre	1,000	15,000
Pasture and Hayland Planting	Acre	500	15,000
Farm Pond	No.	75	15,000
TOTAL		XXXXX	60,245

1/ Price Base: 1964

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Cooper Creek Watershed, Arkansas

(Dollars) 1/

Structure Site Name or Number	Installation Cost - Public Law 566 Funds: Construction	Installation Services: Engineering	Installation Services: Other	Total P. L. 566 Funds	Installation Cost - Other: Adm. of Contracts	Easements and R/W	Total Other	Total Installation Costs
Floodwater Retarding Structures								
1	199,419	35,895	17,943	253,257	1,000	7,295	8,295	261,552
2	249,787	44,962	22,474	317,223	1,260	8,070	9,330	326,553
3	96,164	17,310	8,652	122,126	490	9,435	9,925	132,051
4	115,425	20,777	10,385	146,587	590	10,812	11,402	157,989
5	92,578	16,664	8,329	117,571	470	8,840	9,310	126,881
6	51,596	9,287	4,642	65,525	260	2,937	3,197	68,722
7	45,626	8,213	4,105	57,944	230	4,112	4,342	62,286
8	55,843	10,052	5,025	70,920	280	6,642	6,922	77,842
9	35,728	6,431	3,215	45,374	180	4,835	5,015	50,389
Subtotal	942,166	169,591	84,770	1,196,527	4,760	62,978	67,738	1,264,265
Stream Channel Improvement and Appurtenances	39,868	7,176	3,587	50,631	205	28,680	28,885	79,516
TOTAL	982,034	176,767	88,357	1,247,158	4,965	91,658	96,623	1,343,781

1/ Price Bases: 1963 and 1964.

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES
Cooper Creek Watershed, Arkansas

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9	Total
Drainage Area	Sq. Mi.	7.60	12.14	3.22	4.83	4.44	1.33	1.72	2.67	1.30	39.25
Storage Capacity											
Sediment											
Sediment Pool (Below Riser)	Ac. Ft.	272	434	115	90	83	25	32	102	50	1,203
Sediment Reserve	Ac. Ft.	324	518	137	111	102	30	40	128	63	1,453
Floodwater Pool	Ac. Ft.	154	246	65	51	47	14	18	61	30	686
Floodwater	Ac. Ft.	2,513	4,016	1,063	1,930	1,468	441	568	882	431	13,312
Total	Ac. Ft.	3,263	5,214	1,380	2,182	1,700	510	658	1,173	574	16,654
Surface Area											
Sediment Pool (At Riser)	Acre	34	45	21	19	18	4	9	24	17	191
Sediment Reserve	Acre	52	77	34	31	28	10	14	41	29	316
Floodwater Pool	Acre	171	221	102	153	131	45	69	123	85	1,100
Volume of Fill	Cu. Yd.	250,440	333,530	147,040	192,250	127,120	59,580	50,950	76,830	40,560	1,278,300
Elevation Top of Dam	Foot	393.0	463.8	428.1	374.9	325.6	318.1	303.0	299.2	311.2	XXXXXXXXX
Maximum Height of Dam	Foot	59	74	46	49	42	35	32	28	24	XXXXXXXXX
Emergency Spillway											
Crest Elevation	Foot	388.4	458.1	423.7	370.4	321.3	315.1	299.9	296.2	308.2	XXXXXXXXX
Bottom Width	Foot	200	200	75	200	120	50	50	120	25	XXXXXXXXX
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	XXXXXXXXX
Percent chance of use 2/		4.0	4.0	4.0	2.5	4.0	4.0	4.0	4.0	4.0	XXXXXXXXX
Average Curve No. - Condition II		80	80	80	80	80	80	80	80	80	XXXXXXXXX
Emergency Spillway Hydrograph											
Storm Rainfall (6-hour)	Inch	5.7	5.7	5.7	8.5	5.7	5.7	5.7	5.7	5.7	XXXXXXXXX
Storm Runoff	Inch	3.52	3.52	3.52	6.09	3.52	3.52	3.52	3.52	3.52	XXXXXXXXX
Velocity of Flow (V_c) 1/	Ft./Sec.	0	0	0	0	0	0	0	0	0	XXXXXXXXX
Discharge Rate 1/	C.F.S.	0	0	0	0	0	0	0	0	0	XXXXXXXXX
Maximum Water Surface Elev. 1/	Foot	-	-	-	-	-	-	-	-	-	XXXXXXXXX
Freeboard Hydrograph											
Storm Rainfall (6-hour)	Inch	15.0	14.8	15.0	18.8	15.0	13.0	13.0	15.0	15.0	XXXXXXXXX
Storm Runoff	Inch	12.4	12.2	12.4	16.1	12.4	10.4	10.4	12.4	12.4	XXXXXXXXX
Velocity of Flow (V_c) 1/	Ft./Sec	9.3	10.6	9.1	9.2	9.1	7.2	7.3	7.4	7.3	XXXXXXXXX
Discharge Rate 1/	C.F.S.	5,562	7,771	1,774	4,798	2,704	582	613	1,536	310	XXXXXXXXX
Maximum Water Surface Elev.	Foot	393.0	463.8	428.1	374.9	325.6	318.1	303.0	299.2	311.2	XXXXXXXXX
Principal Spillway											
Capacity - low-stage	C.F.S.	138	229	76	102	96	23	37	64	27	XXXXXXXXX
Capacity Equivalents											
Sediment Volume	Inch	1.85	1.85	1.85	0.98	0.98	0.98	0.98	2.05	2.05	XXXXXXXXX
Detention Volume	Inch	6.20	6.20	6.20	7.50	6.20	6.20	6.20	6.20	6.20	XXXXXXXXX
Spillway Storage	Inch	2.06	2.14	2.97	2.94	2.66	2.04	2.69	2.85	4.11	XXXXXXXXX
Class of Structure		A	A	A	B	A	A	A	A	A	XXXXXXXXX

1/ Maximum during passage of hydrograph.
2/ Based on regional analysis of gaged runoff and exceeds the minimum 6-hour volume set forth in Engineering Memorandum SCS-27.

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TABLE 3A - STRUCTURE DATA - CHANNEL

Cooper Creek Watershed, Arkansas

Channel Designation	Station Numbering for Reach: Station to Station (100 ft.)	(100 ft.)	Uncontrolled Watershed Area (sq. mi.)	Required Drainage Curve 1/	Release from Controlled Area (c.f.s.)	Required Channel Capacity (c.f.s.)	Planned Channel Capacity (c.f.s.)	Average Bottom Width (feet)	Average Side Slope (H/V)	Average Depth (feet)	Average Slope (ft./ft.)	Average Velocity in Channel (f.p.s.)	Volume of Excavation (1,000 cu. yds.)
1	460 + 27	659 + 00	14.7	$45M^{5/6}$	631	1,251	1,292	28	1.5:1	7.4	.0007	4.25	60.7

1/ $Q = 45M^{5/6}$ was used for uncontrolled bottomland, and $Q = 80M^{.753}$ was used from uncontrolled hill land.

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TABLE 4 - ANNUAL COST

Cooper Creek Watershed, Arkansas

(Dollars)

Evaluation Unit	Amortization of Installation Costs 1/	Operation and Maintenance Costs	Total
Floodwater Retarding Structures 1 through 9, Stream Channel Improvement and Appurtenances	44,022	2,620	46,642
TOTAL	44,022	2,620	46,642

1/ Price Bases: 1963 and 1964. Installation cost amortized over 100-year period at 3.125 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Cooper Creek Watershed, Arkansas

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	37,411	16,135	21,276
Other Agricultural	5,123	775	4,348
Nonagricultural			
Road and Bridge	4,118	218	3,900
Subtotal	46,652	17,128	29,524
Erosion			
Flood-Plain Scour	4,581	2,335	2,246
Indirect	5,123	1,946	3,177
TOTAL	56,356	21,409	34,947

1/ Long-term prices, as projected ERS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Cooper Creek Watershed, Arkansas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost 4/	Benefit-Cost Ratio
	Flood Prevention							
	Damage Reduction	Changed Land Use	Incidental Recreation 2/	Secondary	Redevelopment	Total		
Floodwater Retarding Structures 1 through 9, Stream Channel Improvement and Appurtenances	32,432	19,547	5,258	6,754	2,220	66,211	46,642	1.4:1
TOTAL	32,432 3/	19,547	5,258	6,754	2,220	66,211	46,642	1.4:1

1/ Long-term prices, as projected by ERS, September 1957.
2/ Benefits to recreation are incidental to the installation of floodwater retarding structures.
3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $2,515, annually.
4/ From table 4.

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INVESTIGATIONS AND ANALYSES

Land Treatment

The conservation needs inventory and the work unit technical guide provided information on land capabilities and conservation needs for the watershed.

Land treatment measures already applied and the cost per unit of application for each measure were obtained from unit records and farm operators. This information was used in preparing the land treatment portion of table 1A.

Land treatment measures to be applied during the project installation period were determined on the basis of the amount of treatment required for the initial increment for watershed protection and flood prevention. A systematic field survey by the United States Forest Service determined the hydrologic condition of the forest land cover condition and treatment needs. The amount of remedial measures was determined from this survey, supplemented by data and information provided by local agencies and forestry officials. The forest land treatment measures recommended are based on total conservation needs, adjusted for owner participation and limited to the installation period of the watershed program. The hydrologic, geologic, and economic investigations provided data as to the effects of these measures in terms of the reduction in flood damage. Consideration was given to the personnel available for planning, funds available for ACP cost sharing, and the resources of farm operators for installing their share of the land treatment measures.

Engineering

A base map of the watershed was prepared to show the watershed boundary, drainage pattern, system of roads, and other pertinent information.

Tentative locations for 9 floodwater retarding structures were selected by stereoscopic photo-study and field examination.

1. Topographic maps with 5-foot contour intervals and a scale of 1 inch = 660 feet were developed by stereoplotting of the pool area of each site. The height of the dams and the size of the pools were determined by the storage volumes needed to detain the runoff from the design storm and to provide the additional storage needed for sediment in the floodwater retarding structures.

2. Structure data tables were developed to show the drainage area, storage capacity planned for floodwater detention, sediment storage, release rate of the principal spillway, emergency spillway capacity, area inundated by the pools, and other pertinent data for each structure (table 3).

3. The floodwater retarding structure detention storage volumes, based on regional analyses of gaged runoff for multiple-day storms, outlined by Watershed Memorandum AK-302, as a guide, meets these requirements in all structures, after allowance for a release rate varying from 17.3 c.s.m. to 24.0 c.s.m.

4. Stream channels originate in the northern part of the watershed. The plan is to protect the flood-plain area from the rapid runoff and large volumes of flow by the use of floodwater detention structures. The channel improvement is designed to accommodate the flows equal to the runoff from uncontrolled hill land, based on the formula, $Q = 80M^{.753}$, and bottomland, based on the formula, $Q = 45M^{5/6}$, in addition to the principal spillway release from floodwater structures:

   Q = required channel capacity in cubic feet per second.

   M = drainage area in square miles.

Hydraulic and Hydrologic

The following steps were taken as a part of the hydraulic and hydrologic investigations and determinations:

1. Basic meteorologic and hydrologic data were tabulated from United States Weather Bureau Climatological Bulletins for the Black Rock, Arkansas, rainfall station and Strawberry River Geological Survey water supply papers. These data were analyzed to determine average precipitation and the historical flood series to be used to evaluate benefits in the agricultural reaches.

2. Engineering surveys were made of the forty-six stream channel and valley cross sections, of which twenty were on the main stem of Cooper Creek; nine on drains 1, 2, and 3; twelve on Dry and Mill Creeks; and five on Strawberry River. These cross sections were selected to represent the stream hydraulics, flood-plain area, and to determine the needs of the economist and geologist.

3. The present hydrologic condition of the watershed was determined from data furnished by local, state, and federal agencies. This included existing soil surveys, land use and land treatment data, provided by the area and work unit conservationists and soil scientist. The United States Forest Service provided hydrologic conditions and runoff curve numbers for the woodland, both present and future. Consideration was given to other factors such as geology, cropping practices, topography, soil cover, and climate.

   The future hydrologic condition was developed from data furnished by the work unit relative to expected changes in land use resulting from an accelerated land treatment program during the project installation

period. Present and future II condition soil cover complex curve numbers are 81 and 80, respectively. The twenty-year historical flood series of 1932 to 1951, inclusive, was used in evaluation of valley reaches.

Runoff-peak discharge relationships for all evaluation reaches were determined by stream reach routings by the Convex Method.

4. Hydrologic conditions for the woodland for both present and future conditions were furnished by the United States Forest Service.

5. Determination was made of peak discharges and areas inundated which would exist due to:

   a. Present condition of the watershed.

   b. Effect of all land treatment measures.

   c. Effect of land treatment measures and floodwater retarding structures.

   d. Effect of land treatment measures, floodwater retarding structures, and channel improvement on portions of reaches 2 and 3.

Stage-discharge-area inundated relationships for valley cross sections were developed by computing water surface profiles by Doubt's Method, using a digital computer program, as outlined in SCS Technical Release Number 14.

Runoff-area inundated curves were developed for each evaluation reach by a summation of the area flooded, by depth increments, for each cross section in the evaluation reach.

The common flood plain of Cooper Creek and Strawberry River was evaluated as a stream reach of Strawberry River. A hydrograph developed by the Corps of Engineers for Strawberry River at a point approximately 9 miles upstream from Cooper Creek was routed down Strawberry River under present conditions, and with planned structural control on Big Creek and Reed Creek of Tri-County Watershed (now being planned), and on Cooper Creek. Benefits due to planned structural control on Strawberry River were then prorated to Cooper Creek on the basis of area control.

Freeboard inflow hydrographs, computed using antecedent moisture condition II and future runoff curve number 80, were used to proportion structure emergency spillways since detention storage exceeded the emergency spillway hydrograph volumes. Freeboard hydrographs were developed by the distribution graph method using Watershed Memorandum AK-301 (EWP-H-1, revised October 15, 1963) as a guide. A six-hour point rainfall of 13.0 inches was used on class "a" structures, 15.0 inches for six-hour point rainfall on class "a" structures approaching "b" classification, and 18.85 inches for six-hour point rainfall on class "b"

structures. Emergency spillway designs for the structures were obtained by graphical flood-routing method number 2, outlined in NEH-5, page 5.8-12. Minimum design criteria for all structures were exceeded, with respect to volume of detention storage and runoff amounts used, to design emergency spillway, and establish top of dam elevation.

The April 14-15, 1945 rainfall of 4.69 inches and corresponding direct runoff of 4.11 inches, the largest spring storm in the twenty-year historical evaluation series, was used to define the maximum flood-plain area for use in computations of damages and benefits.

An estimated peak discharge of 19,500 c.f.s. for this storm, under present conditions, occurred at reference valley section 5. After installation and full functioning of the measures proposed in this plan, the modified peak discharge at the same point for this storm would be 5,650 c.f.s., a reduction of 71 percent.

Geologic

Preliminary dam site investigations were made on each of the nine floodwater retarding structures. These investigations included studies of rock lithology, stratigraphy, and structure; tentative location of borrow areas and classification of borrow materials; and determination of foundation and spillway conditions. Information gained from the use of a hand auger and portable seismograph implemented investigations. Investigations of the dam sites were intensified because of the presence of cavernous carbonate rock units in the vicinity of the sites.

The bedrock of all of the sites belongs to rock units of Ordovician Age. These are mainly hard consolidated dolomite and limestone rocks, with occasional layers of hard chert. A sandstone rock unit crops out in the vicinity of site number 6. The general trend of the rock structure of minor folding and faulting appears to be in a direction of about north 40 degrees east. Some sulfide mineralization occurs through the area, mainly at depth, but not in sufficient quantities to influence the strength of the limestones and dolomites. The limestones and dolomites are generally medium to massive bedded with well developed joint systems. Solution caverns are numerous in the massive bedded strata of limestones and dolomites.

Small areas of perched water tables occur in the vicinity of site numbers 1, 4, and 6. Sufficient water for construction will be available in the streams of all of the sites except site number 6, during years of normal rainfall.

Borrow materials occur in relatively shallow deposits of alluvium on all of the sites except site numbers 8 and 9. These two sites have an abundance of borrow material available. The borrow materials are mostly CL, SM, SC, and GM soil and alluvial material.

All of the sites appear to have sufficient foundation strength for the proposed dams; however, the hackly nature of the bedrock surface will make selection of principal spillway conduit locations and tie-in of embankment materials with the rock surfaces difficult.

Site numbers 1 and 6 have solution caverns at or near the proposed dam locations. Site number 6 appears to straddle an ancient inactive fault. These factors were considered in the cost estimates of these structures.

Foundation drains are recommended for all of the structures because of the nature and presence of bedrock in the structure foundations.

Emergency spillways will be cut through bedrock on all of the sites except site numbers 8 and 9 which will have emergency spillways in CL soil material.

It is pertinent that detailed geologic investigations using appropriate power equipment will be made on all of the nine dam sites prior to final design of the structures. Geologic investigations using power drilling equipment should be made along the section of proposed channel improvement on Cooper Creek prior to final design of the channel improvement.

Sedimentation

Sediment sources were located and evaluated by field mapping methods. The total subwatershed areas of three of the proposed structures, or 25 percent of the upland area, were mapped by soil, slope, and vegetative cover condition; and the total annual gross erosion rates were determined for these sample areas by the use of the Musgrave Equation. The rates derived by this method were projected to other respective upland areas. Sediment delivery ratios of the subwatershed areas and the trap efficiencies of the structures were calculated, and the sediment storage for each reservoir was determined. The present average annual gross erosion from watershed uplands is estimated to be 12.61 tons per acre, or a total of 479,075 tons. This is equivalent to one foot of soil loss on a 238-acre farm each year. The installation of land treatment measures will reduce the annual gross erosion to about 9.74 tons per acre. All proposed project measures will reduce the sediment yield to the bottomlands by an estimated 71 percent.

Twenty-five acres of the bottomland are receiving overbank deposition from the streams in the upper reaches of the valleys. Approximately 114 acres of bottomland are being damaged slightly by swamping in reaches 3 and 4. Overbank deposition and swamping are minor watershed problems. Scour damages are affecting 1,302 acres of the bottomland and are inducing an annual damage of $4,581 to the bottomland.

Valley damages were mapped by measuring each type of damage on selected valley cross sections and by use of aerial photographs in the field. The flooding which occurred in March of 1964 clearly showed the types of

damages which occur on the flood plain and indicated the magnitude of the problems. Observations of the results of this flooding were helpful in clarifying the nature of the damages. Volume and area estimates were computed from the data collected in the field.

Reduction in valley damages will occur with reduction in flooding by project measures since the sediment damages and flooding are interrelated. Flood-plain scour will be greatly reduced because it is related to depth of flow and the velocity of the water over the flood-plain surface. The cultivated land will then recover to a large extent by tilling methods and the buildup of organic matter in the soil.

The following material was used in the development of the sedimentation investigations for this work plan:

1. Barnes, L. N. and Maner, S. B., "A Method for Estimating the Ratio of Soil Loss by Sheet Erosion from Individual Fields or Farms Under Various Types of Land Treatment," USDA, SCS, Fort Worth, Texas, December 1953.

2. Technical Release No. 12 - Procedures for Computing Sediment Requirements for Retarding Reservoirs, SCS, September 1959.

3. Engineering Memorandum SCS-16 - Allocation of Sediment to Floodwater Retarding Structures, 1955.

4. Watershed Memorandum EWP-7 - Sedimentation Investigations in Work Plan Development, USDA, SCS, Fort Worth, Texas, April 1959.

5. Economics Memorandum EWP-1 - Evaluation of Sediment and Erosion Damage to Agricultural Lands, USDA, SCS, Fort Worth, Texas, November 1958.

Economic

Floodwater damage estimates were based on field schedule information obtained from landowners and farm operators in Cooper Creek Watershed. The sampled area was considered sufficient and representative for the purpose of evaluation. Information collected on the field schedules included the present land use, crop yields, probable shifts in crop distribution, and expected land use after project installation.

In addition to information collected on field schedules, many decisions relevant to the economic evaluation were based on information obtained from other local sources: (1) allotted crop acreages in the watershed were secured from the local ASCS office; (2) information from studies concerning yields from crops in different soil capability units was considered ; (3) budgets for major farm enterprises developed by the University of Arkansas Extension Service were used in calculating

production costs and estimated yields; (4) contracting of vegetable production in this area was studied and discussed with one of the contracting companies.

The historical series method was used in the analysis of floodwater reduction benefits. Floodwater and erosion damage were calculated under "without project" conditions and under conditions which will prevail after the installation of each group of measures. Damage for "without" and "with project" conditions was reduced to average annual damage by the following method: crop and pasture damage were adjusted for recurrent flooding. Damages were adjusted to long-term prices and, where necessary, damages were adjusted for any area having a common flood plain with Strawberry River. The difference between average annual damage at the time of initiation of each group of measures and those after their installation constitutes the benefits brought about by that group through the reduction of damages. Benefits from reduction of damages were estimated from the effects of reduction in area and depth of flooding.

Changed land use benefits were calculated for reaches 2 and 5. These reaches will be adequately protected by structures to enable the changes to be made. Other production factors are ideal for the expansion of vegetable production in this area. A vegetable processing market was established here in 1961.

An evaluation of alternative systems of structural measures was made. Reach 3 was evaluated with five structures and seven structures, with and without channel improvement. In this reach, the effects of Strawberry River flooding completely eliminated the damage reduction assigned to channel improvement; however, in reach 2, the present capacity of the channel would be inadequate to carry the release rates of the floodwater retarding structures. Based on this information, channel improvement becomes an essential part of the flood control structural measures. The analysis revealed on the main stem of Cooper Creek and the tributaries, seven floodwater retarding structures plus channel improvement were essential for the desired protection from flooding.

Net benefits for changed land use were determined after giving consideration to the following factors: (1) cost and associated cost; and (2) production adjustment for five-year lag for installation. The lag for accrual of benefits from changed use is based on a five-year gradual buildup of production, a 4 percent interest rate; and a 100-year project life. None of the benefits were derived from increased acreage of allotted or price-supported crops.

Damages to roads and bridges are the main items of nonagricultural damages in this watershed. The county judge and other residents of the watershed supplied information on these damages.

Indirect benefits were estimated to be 10 percent of the floodwater damage reduction benefits.

Areas that will be inundated by the sediment and flood-pool area of floodwater retarding structures were excluded from the damage appraisal. Production to be lost in these areas after installation of the project was compared with the appraised value of the sites. In this analysis, it was considered that there would be no production in the sediment pool. The land inundated by the flood pool was assumed to be converted to grassland under project conditions. Since the value of the easement exceeded the value of production cost, the easement value was used in economic justification.

The evaluation of incidental recreational benefits was limited to those expected to accrue to organized groups or the general public. These benefits were based on the value of a visitor-day of use, and the estimated number of visitor-days of annual use was based on secondary data and field surveys made in the local area. The following factors were taken into consideration in determining the number of visitor-days:

1. The area available for use.

2. Facilities available.

3. The population and population trends within a 50-mile radius of the sites.

4. Accessibility of sites.

5. Recreational capacity for sustained use.

6. The opportunities for different types of recreation by seasons.

A value of 50 cents per visitor-day, less associated costs, was used for determining incidental recreational benefits.

One of the most distinguishing features of the area is the scenic appeal that encompasses the area of sites 1 through 4. It is recognized that all structure sites except site 4 will remain in private ownership. It is expected that site 4 will be developed for recreational use by the community of Smithville. Experience from similar projects and discussions with the sponsors and landowners were the basis for the appraisal that the general public or organized groups will have access to the pool areas. It is expected that access will be provided for a fee or, in some instances, free of charge. All of the structures except sites 1 and 2 are easily accessible, being located within one-fourth of a mile of a county or state road. The associated cost which was used in arriving at the net recreational benefits included the development of the needed access roads.

Project installation will provide opportunities for employment of local labor presently unemployed or underemployed. Data from similar projects indicate that local labor costs in the area approximate 5 percent of

installation costs. This value for the structures was amortized and converted to a redevelopment benefit. The value of local labor employed in project operation and maintenance was treated as a decreasing annuity for 20 years and converted to an average value for the project life and used as a second redevelopment benefit.

Secondary benefits, the net increase in the value of goods and services created by the project, will be realized by workers, processors, and business establishments in the trade area. The evaluation of these benefits was limited to those which will occur locally as a result of project installation.

Local secondary benefits were estimated to equal 10 percent of the other primary benefits, with the exception of those resulting from reduction of indirect damage, plus 10 percent of the increased production expense resulting from changed land use.

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Table A - Summary of Evaluation of Changed Land Use
Cooper Creek Watershed, Arkansas
1964 Prices

Land Use	Unit of Production	Acres	WITHOUT PROJECT Yield Per Acre	Gross Income (dollars)	Direct Production Cost (dollars)	Net Return (dollars)
Soybeans	Bu.	213	24.5	13,212	4,548	8,664
Corn	Bu.	210	51	13,330	7,410	5,920
Sorghum (silage)	Ton	40	10	2,932	1,520	1,412
Vegetables (okra)	Lb.	10	6,000	3,000	1,180	1,820
Meadow	Ton	240	2	10,546	7,200	3,346
Improved Pasture	AUM	160	7	2,744	2,320	424
Pasture	AUM	30	4	294	120	174
Idle	-	15	-	-	-	-
Miscellaneous	-	28	-	-	-	-
Woods	-	79	-	-	-	-
TOTAL		1,025		46,058	24,298	21,760

Land Use	Unit of Production	Acres	WITH PROJECT Yield Per Acre	Gross Income (dollars)	Direct Production Cost (dollars)	Net Return (dollars)
Soybeans	Bu.	213	24.5	13,212	4,548	8,664
Corn	Bu.	210	51	13,330	7,410	5,920
Sorghum (silage)	Ton	40	10	2,932	1,520	1,412
Vegetables (okra)	Lb.	125	6,000	37,500	14,750	22,750
Meadow	Ton	240	2	10,546	7,200	3,346
Improved Pasture	AUM	160	7	2,744	2,320	424
Miscellaneous	-	28	-	-	-	-
Woods	-	9	-	-	-	-
TOTAL		1,025		80,264	37,748	42,516

Increased Net Return With Project - 1964 Prices	20,756
Increased Net Return With Project - Long-term Prices	21,478
Adjusted for Annual Conversion Cost	21,307
Adjusted for Added Flood Damage	19,711
Average Annual Benefits	19,547

September 1964

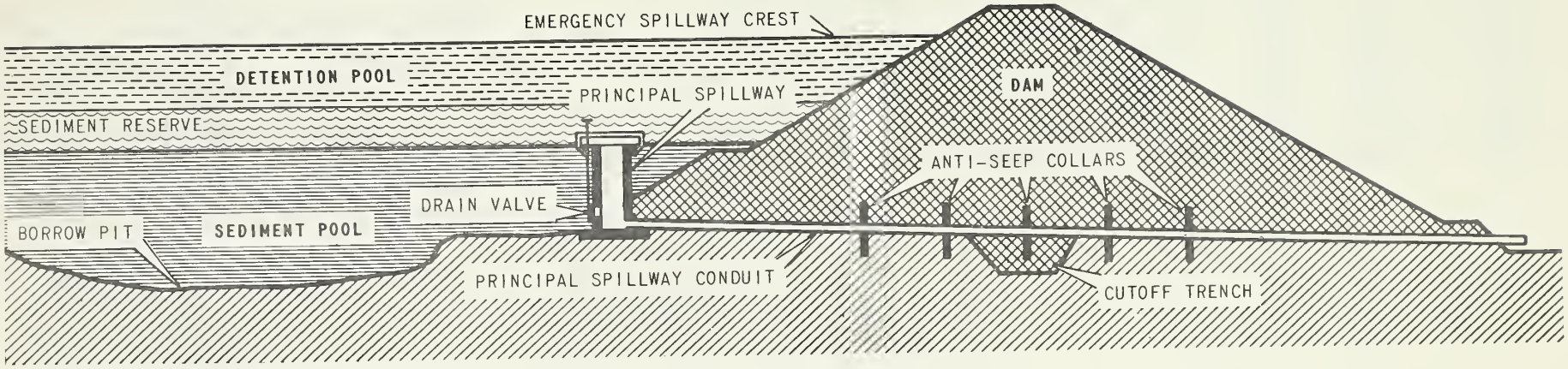


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
USDA-SCS-FORT WORTH, TEX 1965

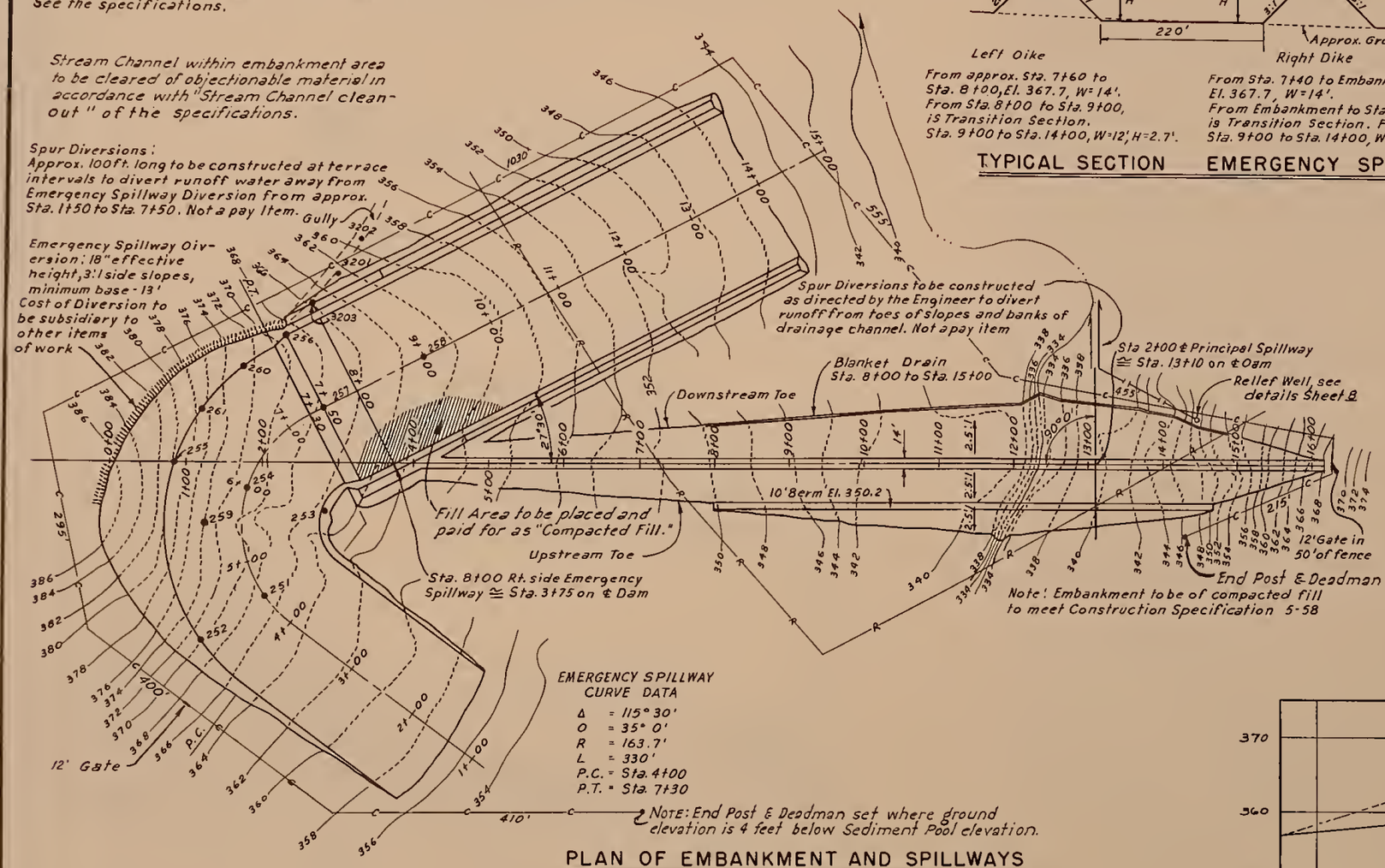
2-65 4-L-19819

A minimum of 6" of topsoil to be placed in emergency spillway and on all "compacted fill areas." See the specifications.

Stream Channel within embankment area to be cleared of objectionable material in accordance with "Stream Channel clean-out" of the specifications.

Spur Diversions: Approx. 100 ft. long to be constructed at terrace intervals to divert runoff water away from Emergency Spillway Diversion from approx. Sta. 1+50 to Sta. 7+50. Not a pay item.

Emergency Spillway Diversion; 18" effective height, 3:1 side slopes, minimum base - 13'. Cost of Diversion to be subsidiary to other items of work.



EMERGENCY SPILLWAY CURVE DATA

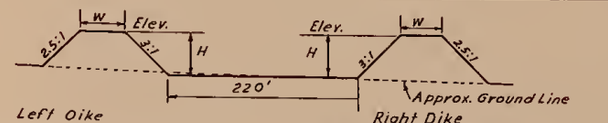
Δ = 115° 30'
D = 35° 0'
R = 163.7'
L = 330'
P.C. = Sta. 4+00
P.T. = Sta. 7+30

Note: End Post & Deadman set where ground elevation is 4 feet below Sediment Pool elevation.

PLAN OF EMBANKMENT AND SPILLWAYS

0 697 1394 1891 2788 3485

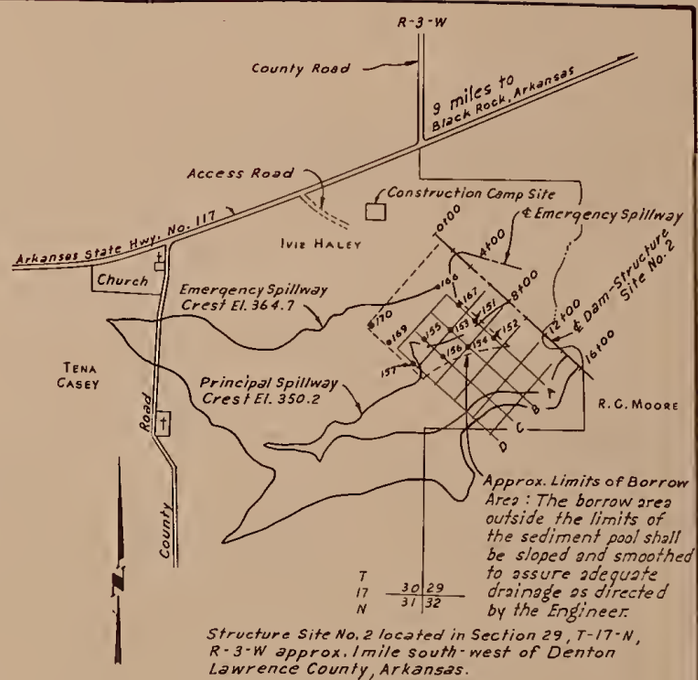
Scale in Feet



From approx. Sta. 7+60 to Sta. 8+00, El. 367.7, W = 14'. From Sta. 8+00 to Sta. 9+00, is Transition Section. Sta. 9+00 to Sta. 14+00, W = 12', H = 2.7'.

From Sta. 7+40 to Embankment, El. 367.7, W = 14'. From Embankment to Sta. 9+00 is Transition Section. From Sta. 9+00 to Sta. 14+00, W = 12', H = 2.7'

TYPICAL SECTION EMERGENCY SPILLWAY



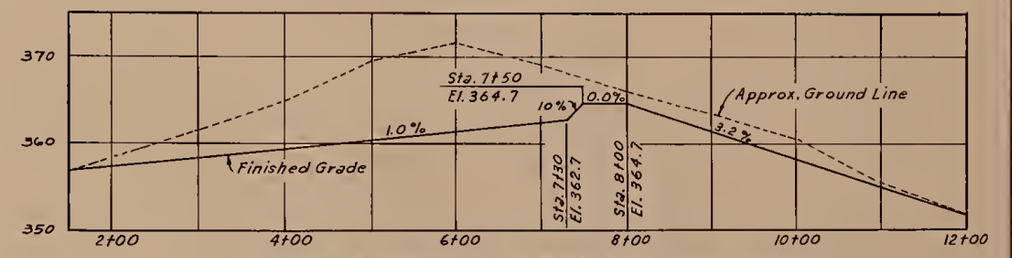
Approx. Limits of Borrow Area: The borrow area outside the limits of the sediment pool shall be sloped and smoothed to assure adequate drainage as directed by the Engineer.

Structure Site No. 2 located in Section 29, T-17-N, R-3-W approx. 1 mile south-west of Denton Lawrence County, Arkansas.

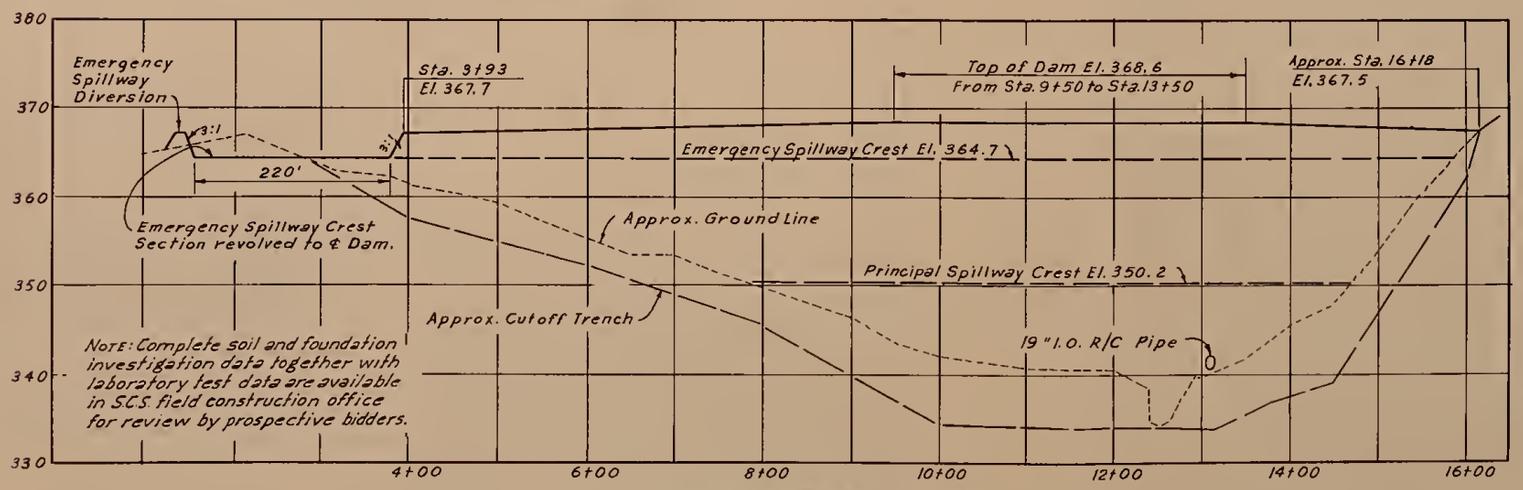
VICINITY MAP AND GENERAL PLAN OF RESERVOIR

0 697 1394 1891 2788

Scale in Feet



PROFILE ON ℄ OF EMERGENCY SPILLWAY



Note: Complete soil and foundation investigation data together with laboratory test data are available in SCS field construction office for review by prospective bidders.

PROFILE ON ℄ OF DAM

Elevation	Surface Acres	Storage Acre Feet	Storage Inches
335.0	0	0	0
338.0	1.1	0.8	0.01
342.0	4.8	12.6	0.11
346.0	12.5	47.2	0.40
350.0	21.0	114.2	0.96
350.2	21.6	119.0	0.98
354.0	30.8	217.8	1.84
358.0	52.4	384.2	3.24
362.0	74.6	638.2	5.39
364.7	86.0	846.0	7.14
366.0	91.9	971.2	8.20
368.6	101.2	1225.0	10.35

Top of Dam (Effective) Elev.	367.5
Emergency Spillway Crest Elev.	364.7
Principal Spillway Crest Elev.	350.2
Sediment Pool Elev.	350.2
Drainage Area, Acres	1422
Sediment Storage, Acre Feet	135
Floodwater Storage, Acre Feet	711
Max. Emergency Spillway Cap., c.f.s.	3694

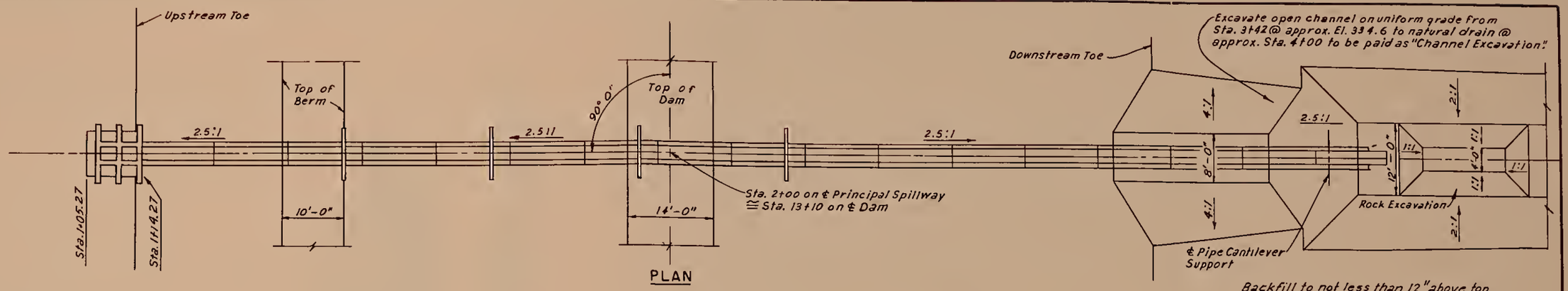
Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

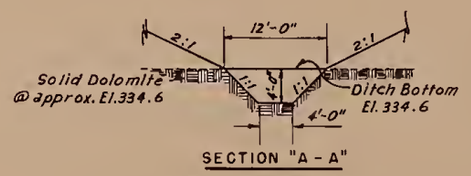
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

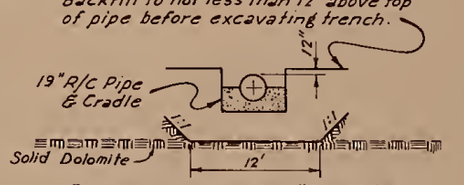
		Date
Designed	W. J. B. & J. E. R.	3-60
Drawn	W. J. B. & M. G. C.	3-60
Traced	M. G. C.	4-60
Checked	C. F. C. & W. J. B.	5-60

Approved by: A. H. M. — Head Engineering & Watershed Planning Unit, Fort Worth, Texas
E. O. B. — State Conservation Engineer S C S
Little Rock, Arkansas
Sheet No. 2 of 8
Drawing No. 4-E-14,512

USOA-SCS-FORT WORTH, TEX. 1965

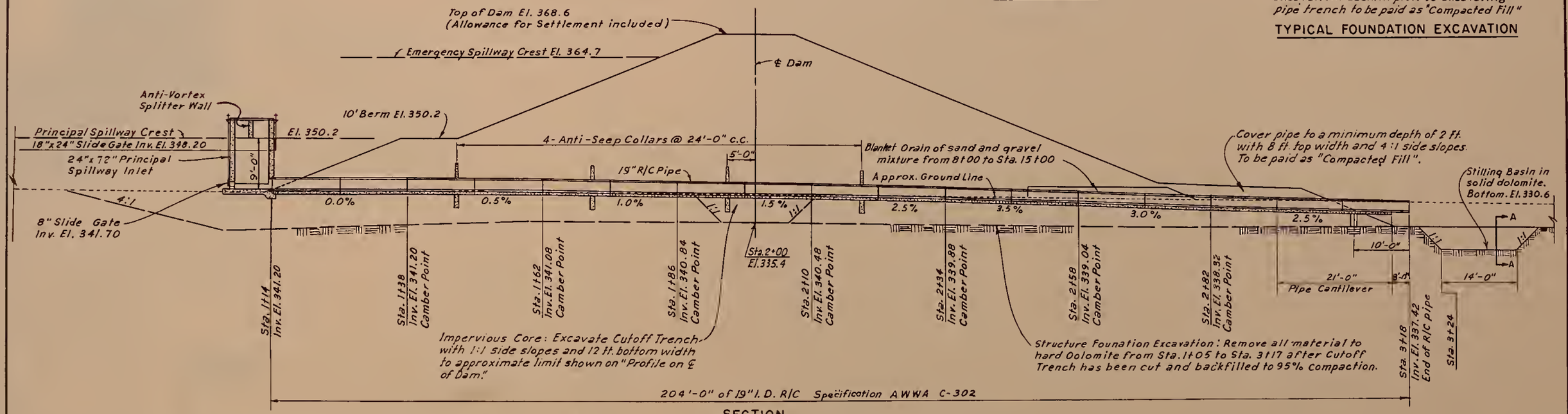






Excavation to be paid as "Cutoff Trench Excavation." Backfill prior to excavating pipe trench to be paid as "Compacted Fill"

TYPICAL FOUNDATION EXCAVATION



SECTION

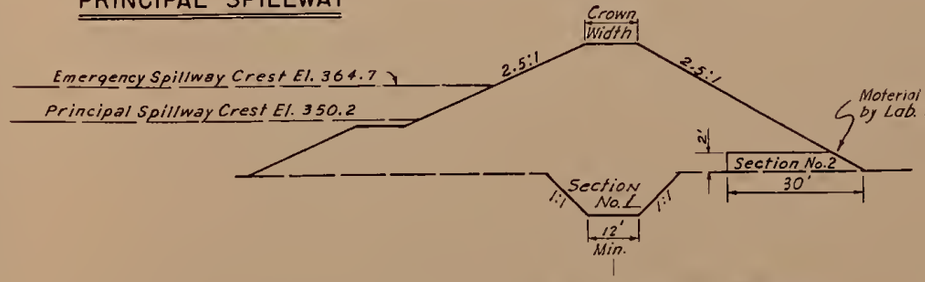
PRINCIPAL SPILLWAY

REQUIRED PLACEMENT OF EXCAVATED MATERIALS										
EMBANKMENT SECTION		SOURCE OF FILL MATERIAL			LAB TEST		COMPACTION REQUIREMENTS			Lab. Curve
Sec No.	Description	Location	Ave. Depth Feet		Standard		Min. Dry Density	Moisture Range Percent		
			From	To	Max Dry Den.	Opt'm Moist	Lbs Per Cu. Ft.	From	To	No.
1	Any except	Borrow - Zone A	2'	12'	117.5	12.5	111.5	12.0	Up	1
	Downstream Toe	Emergency Spillway	2'	8'	108.0	18.5	102.5	18.0	"	5
1	Outer Sections, except Downstream Toe	Emergency Spillway	3'	15'	117.5	12.0	111.5	11.0	"	4
		Borrow - Zone B	2'	6'	121.5	10.0	115.5	9.0	"	2
		Cutoff Trench Excavation	2'	6'	118.0	12.0	112.0	11.0	"	3
2	Downstream Toe Drain Sta. 8+00 to Sta. 15+00	Stream Channel -300' to 500' Downstream								

Note! For delineation of Borrow Zones See Geologic Investigation Sheets.

Zoning Note: "If the material being placed in the fill contains 1/4 inch or larger material in amounts differing from the percentages found in the laboratory sample, the minimum dry density and moisture requirement shown above will be corrected for this variation.

ZONED EMBANKMENT DATA



TYPICAL SECTION - ZONED EMBANKMENT

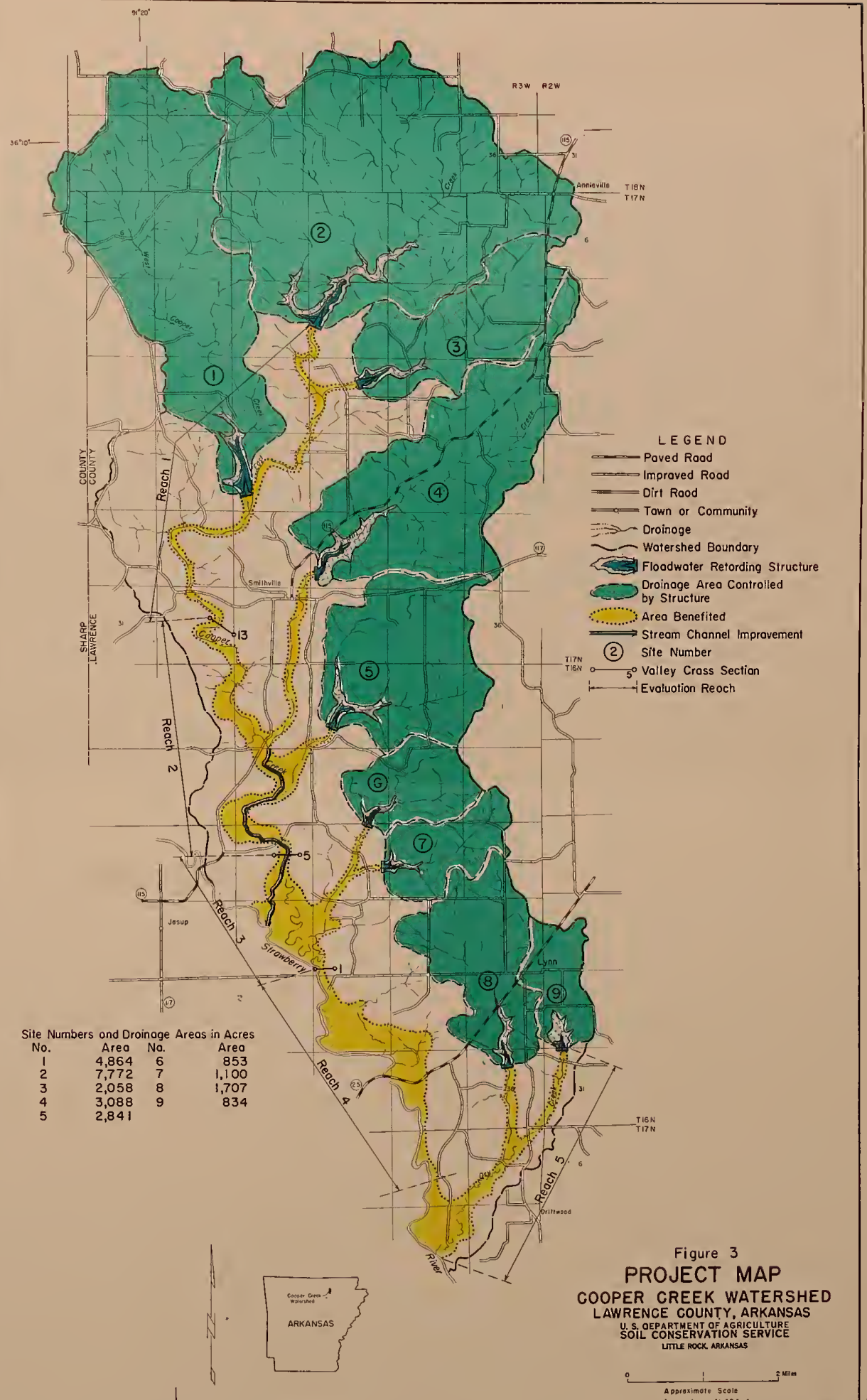
Figure 2A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date
Designed W.J.B. & J.E.R.	3-60
Drawn V.F.R. & M.G.C.	3-60
Traced M.G.C.	4-60
Checked C.F.C. & W.J.B.	5-60

Approved by
HEAD ENGINEERING & WATERSHED PLANNING UNIT
FORT WORTH TEXAS
E.D.B.
STATE CONSERVATION ENGINEER S.C.S.
LITTLE ROCK, ARKANSAS

Sheet No 3 of 8 | Drawing No 4-E-14,512



Site Numbers and Drainage Areas in Acres

No.	Area	No.	Area
1	4,864	6	853
2	7,772	7	1,100
3	2,058	8	1,707
4	3,088	9	834
5	2,841		

Figure 3

PROJECT MAP

COOPER CREEK WATERSHED

LAWRENCE COUNTY, ARKANSAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LITTLE ROCK, ARKANSAS

0 2 Miles
Approximate Scale
Approximate Area 41,424 Acres

7-64 4-R-19188

Base compiled from General Highway Map of Lawrence County, Arkansas, and uncontrolled mosaic No. 4-R-16,303

March 19, 1962 4-R-16,500